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Sixty-inch Pulley Lathe.

The accompanying engraving shows an improved 60-inch pulley lathe, which is just being put on the market by the Lodge & Davis Machine Tool Co., Cincinnati, O.

While this machine is very heavy and rigid it is so designed as to admit of easy and rapid operation. The features of this lathe that are considered especially valuable are the universal chuck for centering and turning up pulleys, the design of the rail and feed mechanism for facing and turning taper to the full swing of the lathe, and the arrangement for boring and turning simultaneously.

The live spindle is of large diameter, with long bearings, provided with means for taking up wear. The driving gearing is so arranged that two different grades of speed can be obtained; one for turning and one for polishing.

The chuck as shown on machine is of new design; around its hub is journaled a gear meshing with three pinions, which operate universally by means of bevel gears, three screw studs which center the pulley by the inside of rim. After being thus centered, the pulley is chucked by the arms with adjustable clamps to avoid springing.

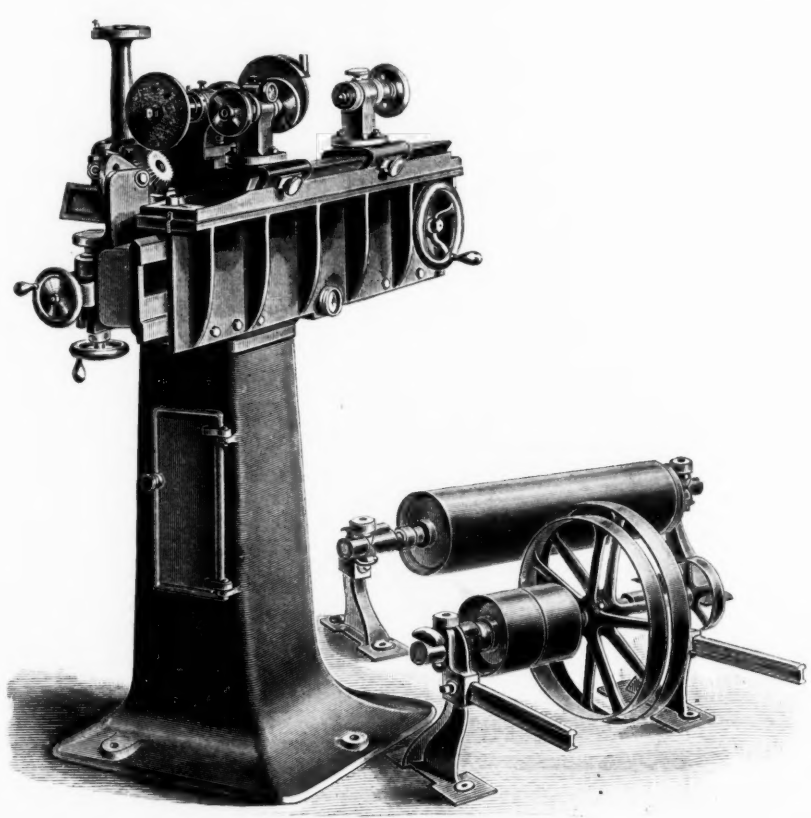
The feeds for the tool slides and foot stock spindle are obtained from a friction disk, located under the front spindle bearing, and the feed can be varied from 0 to ¾ of an inch, by a knurled knob.

The rails carrying the tool saddles can be set by graduation at any angle for crowning. The front rail is so arranged that it can be set clear across the bed bearing on both sides, so as to face work or turn any taper to the full swing of the lathe. The feed for this purpose is derived from the worm wheel shaft through a series of bevel gears, and a telescoping shaft.

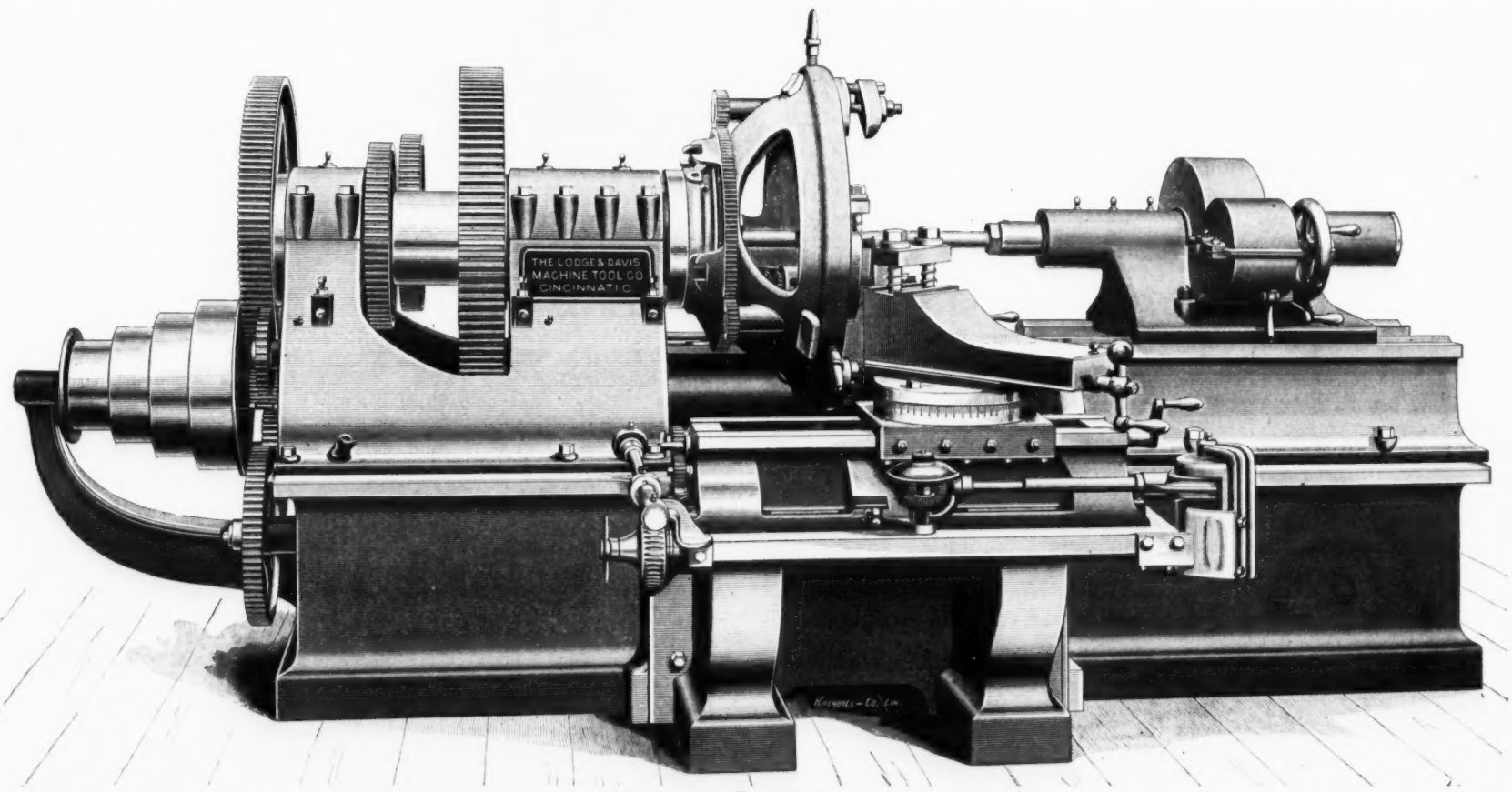
The foot stock slides by means of a rack and pinion on an intermediate shear, which again can be moved by the same contrivance to or from the head of the main bed.

The power for driving the foot stock spindle is obtained from the rear end of the head stock by means of change gearing giving different speeds, and transmitted through a splined shaft in the center of the lathe. The starting and stopping is accomplished by a sector tumbler and operated by a handle.

All feeds are operated by knurled knobs. The foot stock spindle is bored taper to receive the boring bar, which enters a gland in the live spindle serving as a guide.



UNIVERSAL AND CUTTER GRINDER.



SIXTY-INCH PULLEY LATHE.

Universal and Cutter Grinder.

The accompanying illustrations (pages 1 and 2) show a new form of grinder recently brought out by A. Falkenau, 11th street and Ridge avenue, Philadelphia.

As indicated by its name, the machine combines two types of machines heretofore kept separate, resulting in an economy of space and cost. It unites the form known as the universal grinder, principally used for the accurate grinding of machine parts, with a form of cutter grinder, for grinding mills, reamers, etc., possessing novel features of some value.

A frame or bed mounted on a square pedestal carries a deep, stiff table, provided with a hand feed. On this is placed a swing-plate which can be set at an angle with the table for grinding tapers, and is graduated in degrees and in tapers per foot. The live and poppet heads are clamped to the swing-plate by drawing them up into a V along its back edge, which not only keeps the top of the plate free of slots in which the water and grit would otherwise lodge, but also insures good alignment of the heads by always drawing them up against the same side of their guide. The live head is furnished with a face plate and chuck; it is capable of swinging around a complete circle horizontally, and its spindle runs in a long, taper, bronze bearing enabling a good fit to be constantly maintained. A dead spindle with a loose driving pulley is furnished for use in grinding work on two dead centers. The poppet head spindle has a spring adjustment, which allows of the expansion of the work during grinding without binding in the centers. The emery wheel slide is mounted on the bed back of the table, and is operated by a hand wheel easy of access by the operator. The wheel

spindle runs in adjustable bronze boxes. An additional spindle is furnished for internal grinding. Both these, as well as the spindles of the live and poppet heads are provided with dust caps to protect their bearings from grit.

At the left-hand end and at the back of the bed is mounted the cutter grinding apparatus. On it, all kinds of end, face, angular and spiral mills, reamers, etc., can be ground on either back or face of teeth. The grinding, instead of being done by the wheel running at right angles across the face of the tooth to be ground, is done with the plane of the wheel nearly in line with the tooth, making it possible to have a practically straight clearance and any desired clearance angle irrespective of the size of emery wheel used. In Fig. 1 may be seen the general arrangement of the parts, which shows an angular mill in place, being ground.

Gear cutters are ground with the faces of the teeth truly radial and equally spaced, insuring a cutter whose every tooth does its proper share of the work. For grinding these a special slide is furnished of which Fig 2 shows a plan view. The gauge indicated by broken lines is used in first setting the cutters.

The machine is arranged for wet grinding and is provided with all necessary overhead works, wrenches, gauge stops and other accessories.

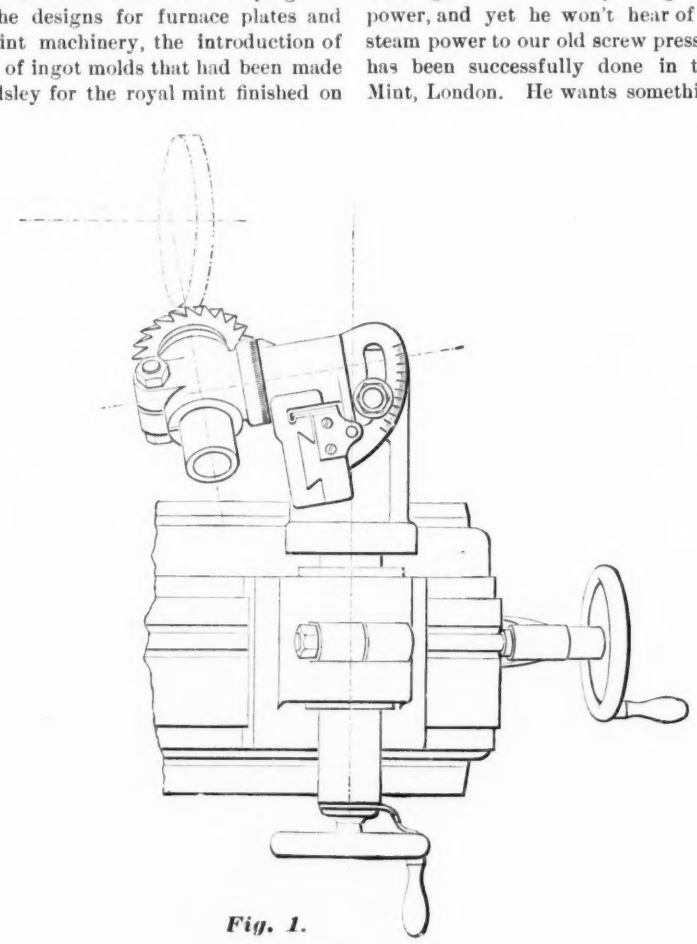


Fig. 1.

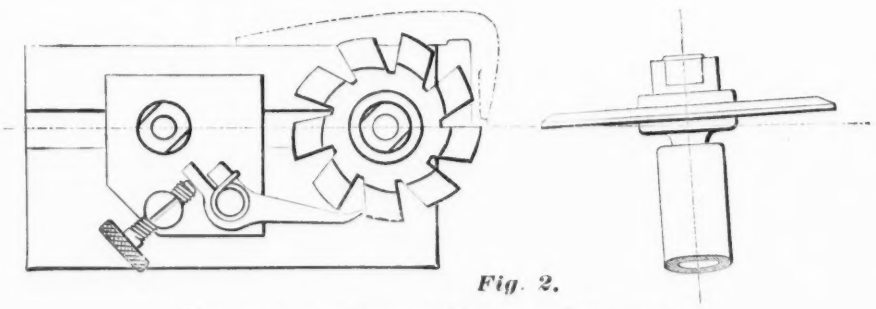


Fig. 2.

UNIVERSAL AND CUTTER GRINDER.—SEE PAGE 1.

Early Engineering Reminiscences.

BY GEORGE ESCOL SELLERS.

THE UNITED STATES MINT—III.

But on that Saturday evening while my brother was getting the weights of the old housings, rolls and their connections, I started on sketches to show Mr. Eckfeldt the extreme simplicity of a horizontal steam cylinder, mounted on a cast iron box bed or shears, instead of on wooden sills, as was the custom at that time. These sketches resolved themselves into two rude colored drawings—an elevation and ground plan. The elevation I have recently found among a lot of odds and ends that have knocked about with me for more than half a century; the finding of this has recalled to memory much of what I am now writing. I worked on these drawings most of the night and probably a good way into Sunday. I kept my appointment at the mint about noon on Monday, taking with me these hastily made drawings; also drawings of the ring metallic packing for piston head as used in our first locomotive, and also a movable model of an arrangement that at that time we were making to regulate by governor the point of cut off. It was a very simple device gotten up by a Mr. Childes, at that time our foreman in finishing shop. It was a simple D slide-valve, but instead of opening and closing the steam ports by its ends it had ports through it, the top of the valve being faced, on which lay a loose plate or valve with two upright stops between which a conical wedge turned so as to regulate the play of this plate and allow the valve proper to slide under it. To insure the top valve traveling with the main valve until stopped, a constant steam pressure on it was secured by a small opening into the escape section of the D valve. This simple little device, the simplicity of the feed pumps as we were then placing them under the steam cylinder operated by an arm from the crosshead and the solidity of the proposed cast-iron bed so pleased Dr. Patterson that he used many arguments to induce Mr. Eckfeldt to give up his vertical hobby; the argument that had the greatest weight was the necessity of the greatest simplicity to avoid being obliged to keep skilled workmen for repairs at such out-of-the-way places as Charlotte and Dahlonega were supposed to be. Should the change be made to horizontal steam engines some change in the designs of the buildings might be necessary. The matter required consideration and probably some correspondence with the architect at Washington. The only conclusion reached at that interview was that we should have the castings and work appertaining to the assay and melting department of the mints, and an appointment made for Dr. Patterson, Messrs. Peale and Eckfeldt to visit our shops at Cardington, the objective point being to see the operation of our planer, which at that time was the only one in Pennsylvania, there being, if I am not greatly mistaken, only two others in the United States, one in Kembal's West Point works, and the other in Dr. Not's—both imported machines. Ours was a very rude affair as compared with the perfect machines of the present time, but by allowing it plenty of time it did good work. Its only automatic action was in the screw-driven bed-plate to give a quicker return; both cross-feed and up and down feed being by hand, requiring constant and careful attention of the operator. The size of the machine would take in and plane 8 feet in length by 4 feet wide and 3 feet high. Its capacity had much to do with shaping and sizing the designs for furnace plates and other mint machinery, the introduction of the kind of ingot molds that had been made by Maudsley for the royal mint finished on his planer, and the increase in silver melts from fifty pounds to over two hundred much sooner than it would have been done if the finishing by cold chisel file and scraper had to be depended on.

A few days after this visit we received notice from Dr. Patterson that the works for the branch mints had been divided. The portion given to us was, in addition to the melting department on which we were then engaged, for the branch mints—the steam engines (horizontal), shafting, rolling mills and milling machines, including the erection and starting of all the machinery. The coining presses and draw benches were given to the Merrick works, then carried on by Merrick, Agnew and Tyler.

This work brought us into almost daily communication not only with Dr. Patterson but with both Peale and Eckfeldt, and I became pretty thoroughly acquainted with every step that was taken during the transition period, as every advance step was very thoroughly discussed, and now as I write so crowd on my memory that I find it hard to cull what may be of interest to the general reader. About this time Mr. Peale was advanced from assistant assayer to that of assayer, melter and refiner (this was in 1836, and to chief coiner in 1839). Although engaged in the radical changes in that department his active mind could not be concentrated on its details alone, fortunately for the public service. He saw room for improvement in handling the metal ingots after leaving his department, and he suggested and planned improvements that have proved to be of great value. Although Mr. Eckfeldt was pleased with what had been accomplished he did not at first look favorably on the improvements Mr. Peale suggested in his special department of chief coiner. He once said to me, "If Mr. Peale had full swing he would turn everything upside down; why he even talks of throwing away our costly coining presses that have done and are doing such good service dispensing with man power, and yet he won't hear of applying steam power to our old screw presses, which has been successfully done in the Royal Mint, London. He wants something better and no doubt he would have it if we were starting anew."

The giving up of almost life-long pets that had been Mr. Eckfeldt's constant care would naturally go hard, and still harder coming from another department, but as improvements gradually crept in and proved their efficiency Mr. Eckfeldt gave full credit where it belonged, and I remember him becoming quite enthusiastic over the labor saving in duplicating working dies. In the fall of 1832 I visited the Royal Mint, but I was hurried through as sightseers generally are. At that time there was in the coining room a row of screw coining presses similar to those in our home mint, save that they were driven by steam power, though the driving power was not visible in the room. The top of the screw still carried its heavily weighted balanced lever, from the momentum of which the coin impression was made; the weighted lever end striking a wooden spring block was thrown back by the recoil opening the dies for thrusting out the piece coined and inserting a fresh planchet. The power was given by a shaft through the ceiling from the power-room above, which by a clutch box, took hold of the top of the screw; this clutch was automatically engaged and disengaged. As Mr. Peale's mission to England was nearly a year later than my visit he must have been acquainted with the entire operation, though I do not recollect among the numerous drawings he made of the machinery of the Royal Mint, any detail drawings of the mode of applying and disengaging the power; and from what I recollect of the conversations had with him on the subject the impression is left that it was anything but satisfactory to him. He dwelt much on the value of progressive up to absolute pressure to be had by the toggle for coining instead of the blow or impact given by the screw with its flying weights. Through daily intercourse and frequent discussions I feel that I have a pretty clear recollection of the progress of his invention of the steam coining press that was so nearly perfect at the first essay.

The original press was exhibited at the Centennial in Philadelphia, in 1876, at work striking medals—it was represented as Peale's first press, and as having been made by Merrick, Agnew & Tyler, under Mr. Peale's supervision. This does not fully agree with my recollection. That firm built the first coining press for coining dollars and half dollars that went into operation in the fall of 1836, at which time Mr. Eckfeldt was chief coiner; Mr. Peale did not take that position until Mr. Eckfeldt's retirement in 1839. The mint repair shop was not fitted with tools for doing heavy work, which was done out at other shops. For the first Peale press the patterns and castings were made at our works, the forgings made and finished from drawings, and were delivered at the mint, and they were mostly put together by Mr. Peale doing much of the work himself. In confirmation of these recollections, I still have the original drawings from which the work was done. I was present when the press was adjusted and the trials made on the copper planchet with the one-cent dies of that period. When properly adjusted it was exhibited coining a one-cent size copper medal, having on its face, around the rim, UNITED STATES MINT, 1836, and in the center and on

the reverse a liberty cap surrounded with rays. The press was then regularly put to work on the copper cents of that period, in the fall of the same year when the dollar press was put to work. A total change was made on the face of the coins. The female figure, with liberty shield, staff and cap, was designed by Thomas Sulley. I do not recollect who made the model in relief from his design, but that of the flying eagle on the reverse, surrounded by United States of America—one dollar, with twenty-six stars on the plain surface, was designed and modeled by Titian R. Peale. From these relief models, which were about 6" diameter, castings were made to be used as templates or tool guiders in the die-sinking lathe. To get these castings satisfactory many experiments were tried in our foundry, finally settling on a kind of speculum alloy not too hard for hand finishing. Although the die-sinking lathe was a labor-saving tool in the rougher portions of die sinking, it did not dispense with the final delicate hand finish, yet Mr. Charles Gobrecht, who was then die sinker, was much opposed to its use. When the first few dollar coins were struck, it was found that Gobrecht had taken the inexcusable liberty of placing his name on the die, which became conspicuous on the coin, and the coinage had to be stopped until it could be obliterated. Mr. Peale's improvement in the draw-bench for equalizing the thickness of the metallic strips, making the return of the grippers to take hold of the strip to be equalized automatic instead of being shoved back by hand, was an important advance in the coining depart-

ment; it was followed by the rotary milling machine for raising the edge of the planchet, which did its work rapidly, only requiring attention in keeping the feed tube supplied with planchets. This was a beautiful machine from an artistic point of view, as was all the machinery devised by Mr. Peale, who brought to his work the refined eye of an artist. Through a hollow column from a tripod base the driving shaft unseen rotated the milling wheel or die by a cam arrangement within the circular table; the planchets were fed from the screwing tube, all the work being automatic, dispensing with the labor of a skilled hand, and doing the work with not less than ten times the rapidity. Those beautiful scales for weighing gold and silver, so plain and simple in appearance, and of such nice accuracy, were of his design, and their final adjustment the work of his own hands.

The small steam engine, so architectural in design, that for many years drove the steam coining presses until their increase called for greater power, was, from its high finish and silent movement, a most attractive object to all visitors to the mint, was of his design, and was constructed under his personal supervision. In planning this little engine, the capacity of the planer I have referred to was a consideration. The table or bed plate was an oblong, hollow cast-iron box, supported on four fluted doric columns, the entire table being finished and polished, as was also the rim of the fly-wheel. These architectural designs for machinery were before the plain, simple, round-cornered and direct forms dictated by utility of the present time, but in their chaste simplicity were a step in the right direction.

During the construction of the engines and machinery of the branch mints, both Dr. Patterson and Mr. Peale were frequent visitors to our works, and on consultation great changes were made from the original plans, in all of which Mr. Peale took active part, taking an immense amount of labor to secure the best practical results.

When we consider that all the improvements in coining were made by Mr. Peale while acting in capacity of assayer, melter and refiner, and were entirely extraneous to the duties due the country in that capacity, and for which the salary — whatever that might be—was considered the equivalent, we can form some idea of how much the country at large is indebted to his inventive genius and zeal. The bulk of the inventions were put into practical operation while Mr. Eckfeldt was chief coiner, and it was not until his retirement in 1839 that Mr. Peale got his reward by being advanced to that position, giving him the management and control of the products of his own brain work. As to what the pecuniary advance was I know nothing. He served in the capacity of chief coiner until the fall of 1854, during which period no essential changes were made in his original steam coining press, milling or other machinery. Improvements were made in minor points, but the general principles remain the same to the present time.

It was alone, as I understand it, due to the doctrine of rotation in office, regardless of fitness, and "to the victors belong the spoils," that Mr. Peale was removed from his position at the very zenith of his usefulness.

One thing remains an enigma to me, and that is that the country was under the same political rule at the time of the dismissal that it was when he entered the service, and he was in no sense a politician in the general acceptance of the term.

I understand that it was mainly through Judge Kelley—who represented a Philadelphia district in Congress—that a bill was introduced and passed giving to Mr. Peale's only child, a daughter, the sum of $10,000 as some consideration for her father's inventions—a free gift to his country. I do not know that I have anything of interest to add to this long rambling talk.

Our subscribers, Messrs. Manion & Harlow, write us from Johannesburg, South African Republic, that that place "is the mining camp of the world." The Chamber of Mines reports the output of gold for March as 111,474 ounces.

The battleships launched for the Royal Navy in 1892 were the "Ramillies," "Repulse," "Revenge," "Resolution," "Royal Oak," "Barfleur," and "Centurion"; the first-class cruisers were the "Crescent," "Gibraltar," "Grafton," "St. George," and "Theseus"; the second-class cruisers were the "Æolus," "Bonaventure," and "Scylla"; and the torpedo gun-vessels were the "Circe," "Hebe," "Leda," "Jason," "Alarm," "Jaseur," "Renard," "Niger," and "Onyx." The aggregate tonnage displacement of these vessels is 148,200; the aggregate indicated horse-power 209,500. The armament of the ships launched in 1892 will consist of 20 13.5″, 8 10″, 9 9.2″, 108 6″, 56 4.7″, 180 6-pounders, 127 3-pounders, and 101 machine guns, or 609 guns in all; and of 108 torpedo ejectors. The total complements of the new vessels of the year will be about 8,800 officers and men.—*The Engineering Review.*

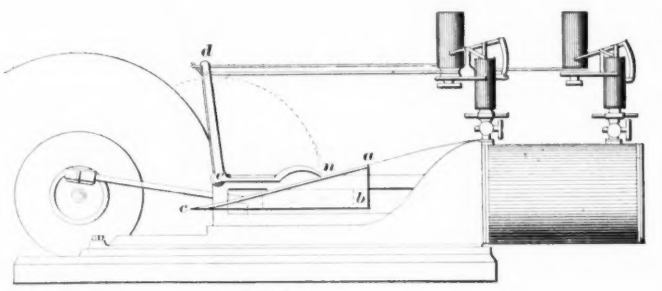


Fig. 1.

Errors in Indicator Reducing Gear.

BY M. E.

There is probably no one point in the whole department of steam engineering upon which engineers are so fanciful as on the choice of indicator rigging. It is certainly not too much to say that one may enter a dozen different engine rooms and find as many varieties of rigs employed. The "Brumbo pulley" in particular seems to be a great favorite with many, but it is employed very indiscriminately, and as often as not, its use introduces errors considerably greater than those it is supposed to correct. If some of the very conscientious individuals who so religiously calculate the horse-power of engines to the third or fourth decimal, would give some little attention to this point, they would possibly learn with surprise that under some circumstances an error of 5 to 10 per cent., or even more, may be easily introduced into the calculation, owing to the use of inaccurate reducing gear.

But while the average engineer may err in this direction, we certainly expect and generally find, due attention given to the matter by experts conducting economy trials as well as by professors in universities and technical colleges. There are, however, indications that some of those who are generally conceded to know something on this point, take too much on trust, and do not trouble to investigate the matter for themselves. This appears, so far as I can see, to have been the case with Professor Carpenter, of Sibley College, who, in the February issue of an engineering magazine, has published a very elaborate economy test of a compound non-condensing engine. The leading dimensions of the engine are very carefully tabulated (except the stroke which is apparently not considered important), and the piston areas are given to the *one thousandth of a square inch*, while the indicator gear is about as inaccurate as it can well be, as I will endeavor to show.

Fig. 1 is a reproduction of the sketch of the gear of which the following is the Professor's description: "The reducing motion used was one often employed by the writer and consists of a cam fastened to the crosshead, and sliding under a 'bell-crank' lever arranged as shown. The construction will, I think, be clearly understood. *a b c* is a triangular cam fastened to the side or top of the crosshead as convenient; *n e d* is a bell-crank lever pivoted at *e*, which is supported by the frame. As the cam *a b c* is moved back and forth under the bent lever *n e d*, the point *n* rises and *d* moves horizontally. The indicator string is attached to *d*, which is of sufficient height to make the string horizontal. If *e n* is made equal to *e d*, *a b* should be equivalent to the stroke of the indicator drum; *b c* should be somewhat longer than the stroke of the engine. The arm *e d* should be vertical when *n* is at the center of the slide *a c*. The point *d* moves in the arc of a circle above *e*, and for this reason the motion is not quite perfect, but the error is exceedingly slight, and due entirely to the rise and fall of the point *d;* the horizontal motion is correct."

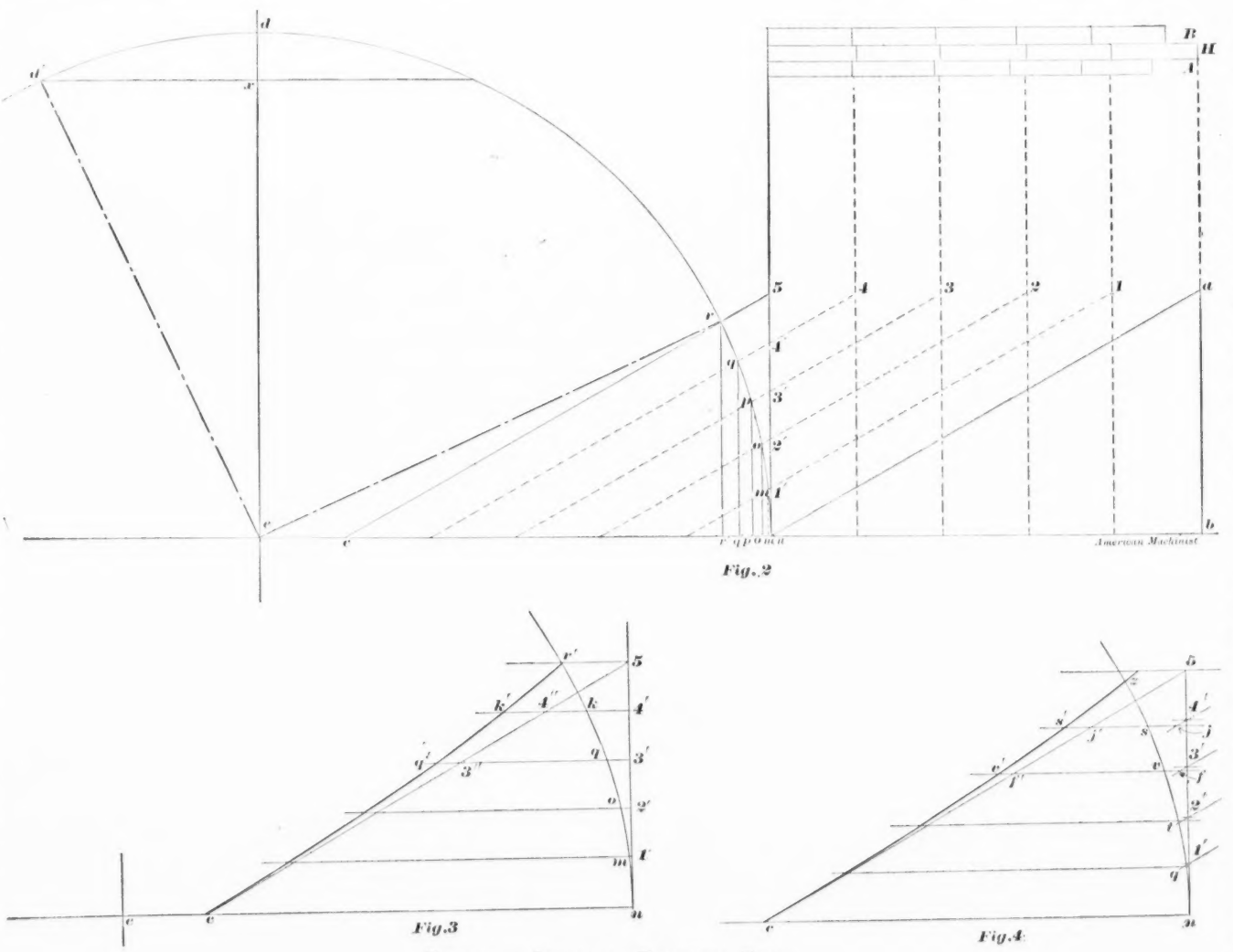


Fig. 2

Fig. 3

Fig. 4

ERRORS IN INDICATOR REDUCING GEAR.

I think from the foregoing description it will be abundantly clear that the piece fixed to the crosshead is an *inclined plane*. It is distinctly so shown in the illustration; it is referred to as a *triangular* cam, while further it is specifically mentioned that if *e n* is equal to *e d*, then *a b* is equivalent to the stroke of the indicator drum, *b c* being somewhat longer than the stroke of the engine. In other words the tangent of the angle $a\,c\,b = \frac{\text{stroke of drum}}{\text{stroke of engine}}$.

Referring now to Fig. 2, let *d e n* represent the bell-crank levers at mid-stroke (*e d* being equal to *e n*), and *a n* one-half of the inclined plane, and *b n* one-half of the engine stroke. The successive positions of the inclined plane or cam, at equal tenths of the stroke, are shown in broken lines, and the corresponding positions of the point *n* are indicated by *m*, *o*, *p*, *q* and *r*. It will be seen that the horizontal motion given to *d* in this way is measured by the lengths of the ordinates *m m'*, *o o'*, *p p'*, etc., drawn from the successive positions of *n* to the base line *e n*. Consequently when the end of the stroke is reached *x d'* instead of being equal to *a b is equal to r r' only.*

In order that the effect of this on the indicator diagram may be duly appreciated, I have shown at *A*, *H* and *B* comparative plottings of the successive positions of the ordinates. Of these, those in the center row *H* represent the true and equal movements of the crosshead, which it is desired to reproduce in the motion of the drum. Row *A* shows the very serious distortion produced by the gear under notice, disregarding the vertical vibration of *d*, while row *B* shows the effect (in this case a beneficial one) of using a Brumbo pulley on *e d*. It will be

seen that the error will be less as the lengths of the lever arms are increased, and as the angle $a\ n\ b$ is decreased. But under the most favorable conditions the gear as described must give inaccurate cards, and with early cut-offs and short stroke engines, the error would unquestionably be most serious. Neglecting this inaccuracy while so specially referring to that due to the angular vibration of the cord, strikes me as being as excellent an example of the straining-at a gnat-and swallowing-a camel business, as I have seen for some time.

The assumption—which has been made in more than one quarter—that the horizontal movement given to the cord is correct, appears to me to be based upon the impression that as the virtual length of the arm $e\ n$ decreases, so also does that at $e\ d$, and in like ratio, and this is, of course, quite true, as far as it goes, and here I may remark, parenthetically, that an English electrical journal reproducing the illustration of this "novel" gear seems also to have reasoned the matter out, but only to this extent, and consequently falls into the common error of supposing that the only inaccuracy is that due to the slight vertical movement of d, previously alluded to. Our electrical friend, however, makes "confusion worse confounded" by gravely stating that this error "may be corrected by adding a curved rim to the lever on which the cord may wrap; this rim to be struck from the center e."

On the assumption made, the idea of adding a Brumbo to $e\ d$, thus making the vertical arm of the bell-crank of constant length, while the virtual length of the horizontal member is continually varying, is amusing in the extreme. As we have seen, the Brumbo does actually better matters, but the "improvement" as here proposed is obviously made in ignorance of the effect of the Brumbo in general, and of the real facts of this case in particular.

Reverting to the gear as shown in Fig. 2, the fact must be taken into account that since n receives its motion by the wedge action of the inclined plane, it follows that as that point rises in its circular path, it runs down the plane, so to speak, and the resulting motion given to n or d is the difference between this action and that due to the wedge action of the inclined plane.

Having shown how inaccurate this gear is, it remains to indicate how it may be modified so as to give correct results. It will be readily perceived that for this purpose all that is necessary is to arrange so that the uniform horizontal movement of the triangular cam shall give a uniform vertical movement to the point n. For this condition to be fulfilled it is necessary that the semi-cords $r\ r'$, $q\ q'$, etc., should be respectively equal to $n\ 5$, $n\ 4'$, and from this the construction is evident. In Fig. 3 $c\ 5\ n$ is the upper half of the inclined plane, as in Fig. 2, and $1', 2', 3'$, etc., are the desired successive altitudes of the point n, corresponding to successive positions of the inclined plane, 1, 2, 3, etc., in Fig. 2. Through these points of altitude, horizontal lines are to be drawn $k\ 4'\ k'$. Then from the point $4''$ there is to be set off on the horizontal, a length $4''\ k' = 4'\ k$. Treating the other points in a similar manner, the curved path $c\ k'\ r'$ is obtained, this being the true shape of the upper half of the working face of the cam required to give a correct horizontal motion to the point d. It will be seen that deviation from a straight line is, in the case selected, very appreciable, and in any case it will be obvious that an inclined plane must always give incorrect results. If an accurately curved cam is to be employed, however, it is desirable to correct the slight error due to the vertical movement of the point d. This may be done by using a Brumbo pulley on $e\ d$, the curve of the cam being suitably modified, as shown in Fig. 4. Here the short inclined lines drawn through $1'\ 2'\ 3'$, etc., represent as before successive positions of the inclined plane, and $n\ z$ the path of n. In this case the horizontal member of the bell-crank is to receive an equal *angular* movement, n moving through equal arcs of the circle for equal movements of the cam. For this construction make the length of the arc $n\ z = n\ 5$, and divide $n\ z$ into 5 equal parts, obtaining points s, v, t and q, through which draw horizontals. Taking the point s, for example, set off from j', on the horizontal $j\ s$, a distance $j'\ s' = j\ s$, j being the point in which the horizontal cuts the inclined line through $4'$. Proceeding in a similar way with the other points we obtain the curved path $z\ s'\ v'\ c$, representing the correct shape of the acting surface of the upper part of the cam when the Brumbo is used. It may be noted that in this case the stroke of the paper drum can be varied as desired by employing Brumbos of different radii without alternation of the cam in any way and without introducing *any error whatever*, while the fact that the cord may be led from the Brumbo to the indicator guide pulley in any direction is also an advantage. It will be understood that in either case the lower half of the cam is obtained by a similar construction to that employed for the upper part.

All things considered, it will be seen that the correct construction of this gear involves much more labor than the incorrect triangular cam and this considerably discounts the advantages which the device undoubtedly possesses. However, for a permanent indicator rig, it will be found very satisfactory, especially if used with the Brumbo as suggested.

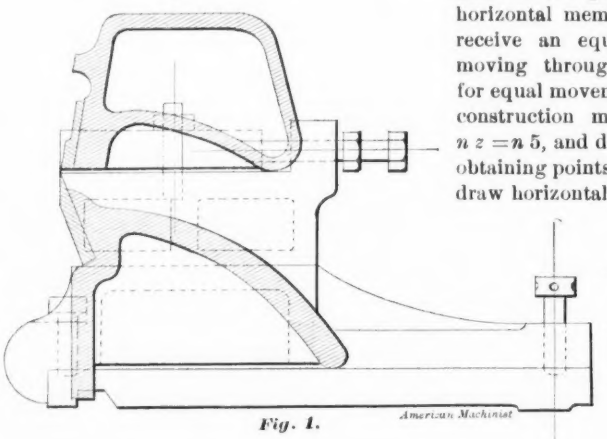


Fig. 1.

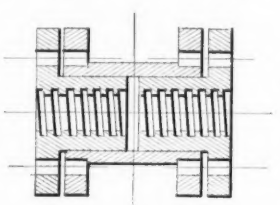


Fig. 2.

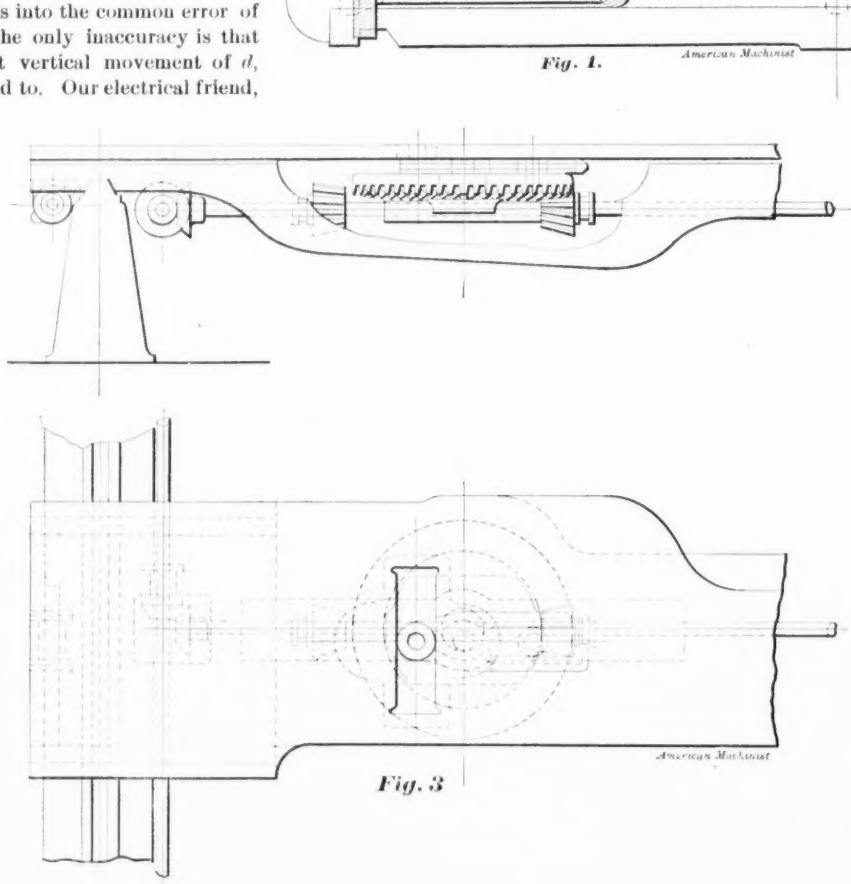


Fig. 3

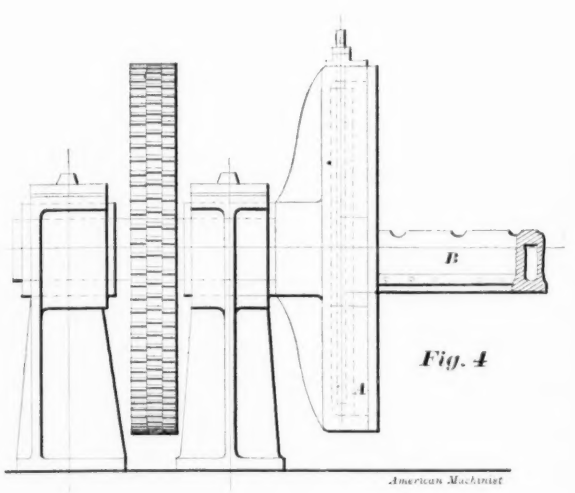
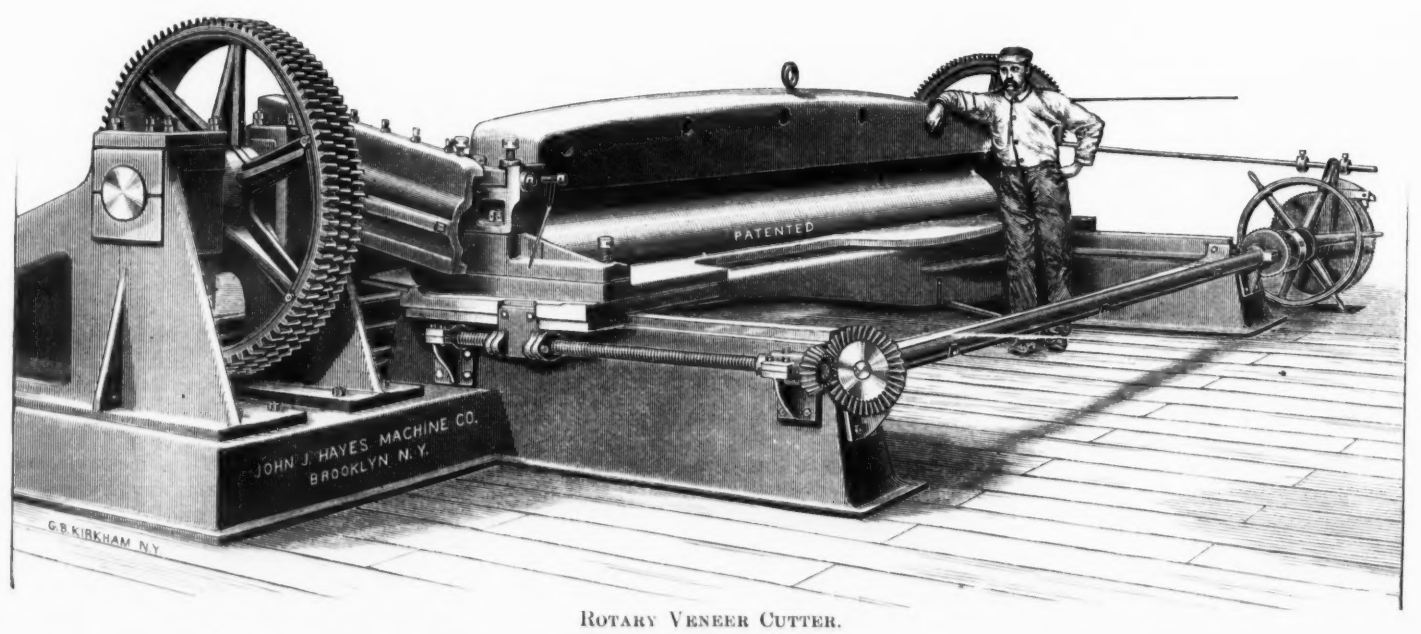


Fig. 4



ROTARY VENEER CUTTER.

Rotary Veneer Cutter.

With this we give a perspective view, and illustrations of important details of a rotary veneer cutter. In the perspective view the rear side of the knife bed and cap is seen; a cross-section of these is shown in Fig. 1. This knife bed, to which the knife is bolted, extends across the machine, and moves along the slides on top of the main bed. It receives this motion by means of the feed screws, one on each side of the main bed; these are actuated either by hand, or by the automatic changeable ratchet feed shown at the end of the main bed. The feed screw nuts, of which a section is shown in Fig. 2, are adjustable to take up the wear.

The log from which the veneer is to be cut is fastened by means of screw bolts to a cast-iron stay log which, in the perspective view, is hidden by the knife bed and its cap, but is partly shown at B in Fig. 4. This stay log reaches across the machine, and each of its ends is attached to a stay log head A, as shown in Fig. 4; these heads are driven by cut stepped spur gears placed at each side of the machine; in fact, the sides of the machine are exactly alike. With these stepped gears smoothness of action is secured, and the liability of breaking the teeth is reduced. In Fig. 4 it will be noticed that the stay log may be thrown out of center by means of the adjusting screw in each head, thus allowing the operator to approximate the cutting of flat veneers.

From the foregoing description, the operation of the machine will be readily understood; the log as it revolves with the stay log heads comes in contact with the knife, thereby cutting the veneers. During the cut the knife bed slides 12 inches horizontally in a transverse direction and back again during the half revolution in which

the log is not being cut. This motion is communicated to the knife bed by means of the gearing shown in Fig. 3, which is arranged so as to allow the knife bed to remain still while cutting, when desirable, by simply throwing the pinions out of gear.

The machine is driven by an 8 inch double belt on a 36-inch clutch pulley; these are not shown in the illustration.

The machine is very strongly built so as to secure rigidity of parts; its complete weight is 20 tons. It will cut a log 12 feet long at the rate of 15 veneers per minute.

These machines are built by The John J. Hayes Machine Co., 108 to 118 West street, Greenpoint, Brooklyn, N. Y.

Columbian Exhibition Notes.

Editorial Correspondence.

The Chicago climate has been giving a little exhibition of its own during the past week which has rivaled the Columbian in interest, and certainly has excited as much comment. First a hot wind blows and every body suffers from heat, especially within Machinery Hall where the natural heat of the air is augmented by the sun shining through the glass roof and the numerous steam pipes underneath the floor, as well as within the building. But then during a single night the wind may change its direction and its temperature to such an extent that overcoats and heavy wraps are in order and Machinery Hall with its hot-house features is generally voted the most comfortable place on the grounds.

The question of Sunday opening having been apparently settled in favor of open gates on that day, the next question to vex the souls of the Exposition Management is that of the system of judging and bestowing awards, the system that has been adopted having met with so much opposition that the representatives of some sixteen foreign countries and a number of American exhibitors have signified their intention to withdraw their exhibits, not from the Exhibition, but from competition for prizes It is claimed that the system it is proposed to follow will place too much power in the hands of one man, and besides will, by giving to all or nearly all exhibitors a medal, deprive the medal of whatever significance it might otherwise have had. How it will turn out, of course no one can at this time tell, but a very good way out of all such troubles would seem to be not to award prizes, or attempt to decide what exhibit may be best in an exhibition of this kind. For really there is a good deal of humbug about the thing, and it is not at all probable that a single person who proposed, for instance, to buy an engine, a machine tool or a wood-working machine would be influenced in the least either in favor of or against any machine by knowing that it did or did not take a prize at this or any other exhibition.

The question of tests of machinery, especially engines and boilers, is one that is attracting some attention, and there seems to have been no adequate provision for securing these, especially in the matter of funds for defraying the expense of them. The authorities of the Exhibition state their desire to have a series of tests, especially of steam boilers and engines, conducted upon the plan recommended by the committee of the American Society of Mechanical Engineers, but declare they have no funds to pay for them. A number of the exhibitors have signified their willingness to defray a share of the expense, however, and it may be that there will be some tests of such machinery conducted in a proper manner by competent and disinterested engineers, after which the defeated exhibitors will begin the usual explanations as to why the conditions were not favorable to them, and the tests were not fair—explanations which by the way they will undoubtedly make satisfactory to a fair proportion of customers, and the mechanical world will wag on about as before.

Though it is undeniable that a prodigous amount of work, and very good work, has been accomplished at Jackson Park since it was decided to hold the Exhibition here, it is very generally recognized that there would have been far less delay in many cases had it been possible for some one man to decide definitely and promptly questions coming within his jurisdiction, instead of being, as there has been, divided authority. It is said, for instance, that if the chief of a department wants a box removed he has to apply in writing to Director-General Davis, who refers the matter to the Council of Administration, who then orders a written communication to Director of Works Burnham, and he directs his assistant to order a janitor to remove the box. Though this may be somewhat overdrawn, possibly, it is thought to give a pretty accurate idea of the circumlocution required to secure any given action, and which has, in many cases, prevented exhibitors from going ahead as fast with the installation as they might have done otherwise. Both Director-General Davis and Director of Works Burnham recognize the difficulty, and both have joined in a written proposition to make the former the supreme authority and the latter his assistant, thus centralizing authority and responsibility as they should be in order to secure prompt and efficient action.

Some of those in charge of engines here are finding out how important it is for them to look closely after their machines and protect them, for some features seem to have been introduced into the piping systems that are liable to give trouble. For instance, the injection water for the condensers is supplied at about twenty pounds per square inch pressure.

One of the Ball compound engines running with an independent condenser happened to lose its vacuum the other day, and the injection water very quickly flooded the cylinder, and something of a wreck resulted, some of the bridges between the ports being badly sprung, and even the walls of the cylinder being so sprung that it was found necessary to go at it with chisel, file and scraper to restore it to shape. The guides were also so much sprung as to require replaning, and the bed of the engine was cracked. How the engine escaped total destruction is something of a mystery, and the effect of the accident upon it seems to show not only that it is strongly constructed but that it possesses the principal characteristic of the wonderful one-horse chaise, and is about equally strong in all its parts.

This reminds me, however, that Prof. Sweet was telling me the other day that he takes pains to avoid this feature of equal strength in the Straight Line, and to do it has in some instances reduced the thickness of pistons to about $\frac{3}{16}$ inch by facing out a ring on each side near the piston rod. This he finds strong enough for ordinary strains, but when water gets into the cylinder the break occurs there and no harm is done, except that a new piston must be provided.

The accident to the Ball engine led Mr. Reuff, who is in charge of the Atlas engines, to put check valves in his exhaust pipes to make sure that no water can back up into the cylinders.

One engineer in charge of a plant here tells me there has been very little systematic work done in the matter of piping up engines, and that in a number of cases at least there seemed to be no predetermined plan worked out by a competent engineer and adhered to, but the pipes were first put in apparently according to some one's notion without drawings, after which some other authority would appear on the scene, condemn the whole arrangement, and order it taken out and changed.

A great many changes have been made in the Mechanical Engineer Corps since the starting of the work, and its organization seems to have been wrong from the start, each new man condemning the work of his predecessors, and, too often, proving it to be faulty.

It can hardly be said that this state of affairs can be charged to any one person, but it is probably due mainly to a combination of unfortunate circumstances; especially those which resulted in division of authority and responsibility as well as frequent changes of personnel during the progress of the work.

It is not supposed that the Sunday opening rule, referred to above, will much affect the machinery men, for it is not expected that any of the machinery will be in motion on Sundays, and it is doubtful if many of the machinery exhibitors will consider it worth while to have any one in attendance on that day when the crowds will naturally be pleasure seeking ones mainly, and little interested in mechanical matters.

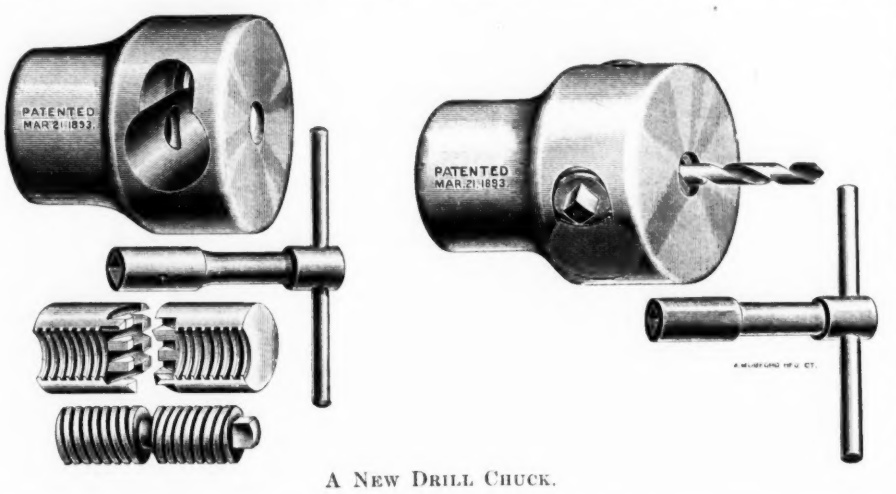
No doubt many sincere and well meaning people are greatly shocked at the Sunday opening plan, but most of them would look at the matter differently, I think, could they be in Chicago for a while, and see how many opportunities there are, and apparently must be for people to do far worse things than to walk about the grounds and buildings of the Exhibition. It has seemed rather inconsistent, for instance, that the Fair gates should be closed on Sunday, while, near one of the main entrances, Buffalo Bill's wild west show with its fusilades of rifle shooting and Comanche yelling should be in full blast afternoon and evening; an actual and palpable disturbance and interference with those who live in the neighborhood, and prefer to spend Sunday quietly.

Among the prominent machinery men and engineers from a distance that have been noticed about Machinery Hall the past week have been Prof. John E. Sweet, Messrs. Whitney and Pratt, of the Pratt & Whitney Co., and Mr. Lucien Sharpe, of the Brown & Sharpe Mfg. Co.

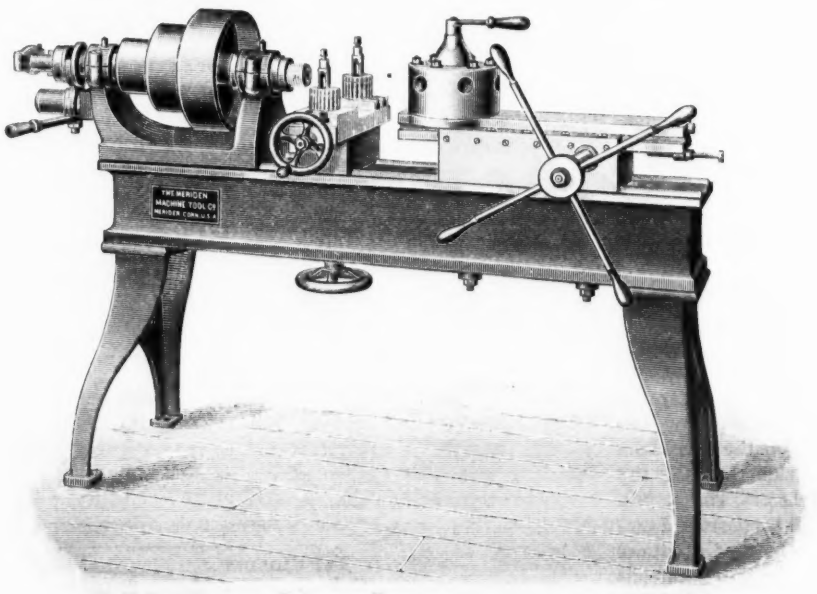
Since writing last week the exhibit of the Sanitary Room Closet Company has been removed from Machinery Hall, but there are yet other exhibits there, that while less objected to by machinery men are yet manifestly out of place, and this is especially true in the foreign sections.

I had hoped by this time to be able to present a number of photographs which would give a very good idea of the general appearance of the interior of Machinery Hall as it is now, but though they are on the way they have been unavoidably delayed, and will have to appear later, after which may appear some others of special features of interest to mechanics, to be seen here. F. J. M.

Jackson Park, May 27.



A NEW DRILL CHUCK.



IMPROVED TURRET LATHE.

A New Drill Chuck.

The drill chuck herewith represented is the invention of C. E. Billings, of the Billings & Spencer Company, and is manufactured and sold by the E. Horton & Son Co., of Windsor Locks, Conn.

This chuck is of that type in which the drill is held between two jaws simultaneously moved by means of a screw having a right and left-hand thread engaging with the jaws. Instead, however, of the jaws being of the usual form where fitting the body of the chuck they are cylindrical, and are thus readily and accurately fitted without the requirement of much skill. These jaws, as will be seen in the engraving, are recessed and threaded on one of their sides in which the screw engages. The groove in the screw engages a central rib in the body of the chuck to retain it in its proper position.

A brief study of the engravings, in one of which the jaws and screw are shown detached, will give a perfectly clear understanding of the construction.

Improved Turret Lathe.

The lathe shown in the accompanying engraving is in many of its features similar to the forming lathe shown in our issue of April 6. It has a cut off slide in place of the forming slide, and the lever for working the chuck is at the back of the head, as is usual in lathes of this class. The lathe can, however, be furnished with the lever at the front the same as the forming lathe; this is the best arrangement (costing but little more), as the motion is easier, and the lever more convenient when in this position.

These lathes are made in two sizes—12-inch, and 18-inch swing; Vanderbeek's countershaft is furnished with the lathe. The manufacturers are the Meriden Machine Tool Co., Meriden, Conn.

The Hartsfeld Methods.

The following communication from Dr. Thurston, Director Sibley College, Cornell University, is to the point, and requires nothing in the way of explanation:

Editor American Machinist:

Your editorial comments on the methods of the "Hartsfeld Furnace and Refining Co., of Newport, Ky.," pungent as they were, do not seem to have disturbed that concern very greatly. They pursue the even tenor of their way and profit, presumably, by the folly of such foundrymen as do not read the AMERICAN MACHINIST. A friend, operating a foundry in New York City, who apparently is not of that party, sends me a slip cut from the later circular of that firm, on which appears the following, under the official letter-head of the Department of Experimental Engineering of Sibley College and Cornell University, and over the signature of the professor in charge:

"Our No. 1 Eureka Mitis Casting Furnace, with your aluminum alloy composite, in use here for experimental purpose among our 500 young college students learning foundry practice, must prove to you a great benefit from an advertising standpoint as to the result from its use here."

My friend asks whether we have used the stuff, whether we get any decided results, and whether this is a forgery. He tells me that he has written to a number of well-known firms, whose names have been used with equal freedom, and all reply, "We are not users of the material;" "We prefer not to pass judgment"—not one commending it. I have replied to his question to the effect that the professor concerned, and the Director of Sibley College have both telegraphed the forgers of that document to cease at once the issuing of the forgery; that no such incoherent and stupid letter was written them; that, had any been written, it would have been expressed in decent English, and would have been private, unless its publication were expressly authorized, and in the form of a regular report on facts; that we have no facts that justify any favorable statement, for advertising purposes or other; and that we have warned them by mail that they are subject to prosecution, by our trustees, for forgery and felony.

Please reinforce your statement of Feb. 23d by these facts, and to that extent add to the obligations of those foundrymen who are wise enough to read your paper, and of

Yours truly,

R. H. THURSTON.

LETTERS FROM PRACTICAL MEN.

Determining the Speed of Vessels by Revolution Curves.

Editor American Machinist:

In defending Commodore Melville's method of determining the speed from a revolution curve extended, after running progressive trials, you say that "any one familiar with laying out curves," etc., knows that within limits the extension of the curve will be true should a higher speed be attained. I therefore ask if this will apply to all types of vessels, as I have seen curves having decided humps, which are true indications of the speeds of the vessel. In this case Commodore Melville's method will not apply, and I venture to say that it will not be true for any of the high-speed vessels recently constructed. Again, should the screws not be adapted to the vessel, how will this method apply? Further you mention that the excess speed was obtained because the air pressure was reduced from one inch to half an inch, but is not this getting beside the question? The truth of the matter is this: The engines were designed to develop a certain I. H. P., and assuming the machinery was efficient, as evidently was the case, the speed obtained was greater by two knots than contemplated, and this is therefore the actual statement of the case. The department was unable to predict the precise result within two knots, which I take it is not a very desirable state of affairs.

The extra speed will probably please the public, but not explain to experts the want of accurate knowledge of the exact power necessary to drive a given ship a given speed, which I think you will agree with me is not a desirable state of things.

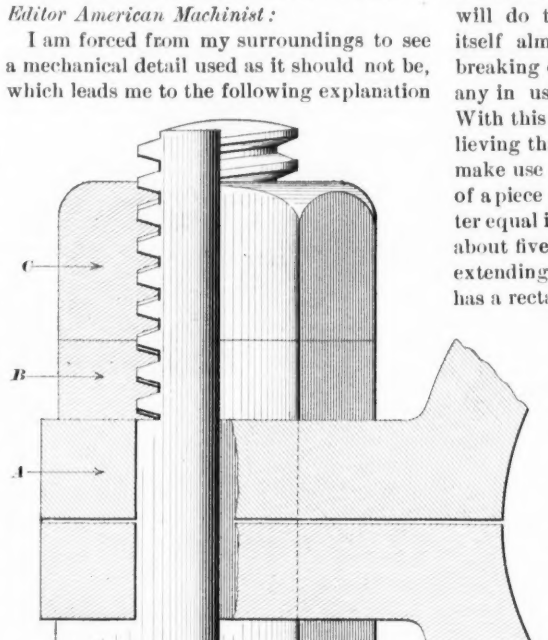
If the "Bancroft" was designed for 12 knots then the power should be adapted to that speed, and any excess obtained shows either a want of confidence in their own methods, or that they are trusting to events to realize their hopes.

J. J. O'NEILL,
Naval Architect.

The Use and the Abuse of Nuts.

Editor American Machinist:

I am forced from my surroundings to see a mechanical detail used as it should not be, which leads me to the following explanation



with sketch. I refer to the use of jam nuts on bolts.

In 99 per cent. of the uses of the nut it has been employed to do just the opposite from what it should do. For instance if the jam nut be half the thickness of the other nut (which is all that is necessary) you will almost invariably find it on the outside of the thick one, whereas it should be the first nut put on the bolt. The thick nut, which does all the work, must be outside as all the strain is on it, and none whatever on the thread of the inside one, *i. e.*, the jam nut, except on the opposite side of the thread, which is caused only by the pressure of the top nut being tightened down on the top of jam nut. See sketch. Top part of thread in nut *C* in contact with lower part of thread on bolt does all the work; see clearance on top side of thread on bolt (made large so you can see plainly). In nut *B* the strain on thread which is only caused by the screwing down of the top nut is directly opposite; therefore no strain on the thread on same side that the top nut has. The strain caused by the cap *A* trying to get off produces no strain on the threads in jam nut *B*, but goes through the body of nut and acts on the bottom surface of the top nut, which in turn is resisted from being pressed off by the top part of the threads in the nut and the lower part of the threads in the bolt.

The top nut must be a proper thickness for the bolt it is used on as it does all the work. Jam nuts must never be used on work that is iron and iron, but where same can be left apart like a pillow block cap, so that there is room for screwing the top nut down on the jam nut and it in turn, being pressed down, whatever the clearance is between thread or nut and bolt, without causing the cap to be too tight on shaft, is well enough. On small bolts, nuts same thickness make a convenience in not requiring a thin wrench, which is necessary where the jam nut is thinner than the main one.

F. W. KIRBY.

Tap Holder.

Editor American Machinist:

Spindle or nut tap holders as a rule are miserable failures. The writer has seen small taps broken almost as fast as the tool makers could make them, and all because the holders did not hold the taps firmly and true in tapping. Where there are thousands of pieces to be tapped in a day it is desirable to have a tap which can be put in the holder without stopping the machine; also a holder which while it holds the tap true and firm will allow it to come out of the holder when strung full of pieces. A holder which will do this is very simple and has proved itself almost a positive cure against the breaking of taps. The writer has never seen any in use except those made by himself. With this I send you a sketch of same believing that a number of your readers can make use of it. The holder consists simply of a piece of tool-steel with a hole in the center equal in size to the shank of the tap and about five times the diameter in length, and extending towards the back end where it has a rectangular shape tapering to the end as shown in Fig. 1. Into this the shank of tap, which is of the same shape, can be pushed and driven. This is for lathe tapping. For vertical tapping a piece of clock spring with a pin, as shown in Fig. II, will hold the tap from dropping. The holders should be hardened. Should this interest any of your readers the writer will be pleased at a future time to describe the manner of making them in from fifteen to twenty minutes.

T. W. MCCABE.

Fig. I

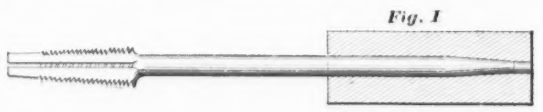
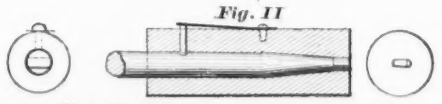


Fig. II



TAP HOLDER.

Theory of the Injector.

Editor American Machinist:

I note Mr. Kinealy's remarks upon my observations, and would say that I agree with them except for the fact that they are quite wrong and misleading. First as to the formula for steam velocity. For the differences of pressure in the exhaust injector this formula is fairly representative. It may not be scientifically accurate, and my object was not to write a treatise on steam flow, but to explain in simple language how an exhaust injector worked. Mr. Kinealy is, however, perfectly at liberty to give us an *exact* formula for steam flow. While he was criticising, too, he might have added for explanation that it is because of the expansive force of steam that a formula for liquids fails to hold good when the pressure differences are large. However, I will pass this to call attention to the very serious misconception conveyed in the subsequent remarks. We do not, I hope, any one of us require to be told that if we deprive steam of its heat it can do no work. Who said it could? Mr. Kinealy goes on to say that if I condense my steam by cold water I cannot force water into the boiler. Now what does he really mean by this? He means that a steam engine will do as much work if you let it exhaust to air and cut out the condenser as it did when condensing. We all know this is not true, yet it is what he really states. Cannot he see that when steam is formed at atmospheric pressure it must have performed work in forcing out the atmosphere from the space into which the steam rises? Is it not a fact that, when exhaust steam at atmospheric pressure, and therefore containing energy in the form of heat sufficient to keep back the whole pressure of the atmosphere, is let into the condenser of the steam engine, it is caused by the abstraction of its heat energy to occupy very little space, and that what we may term the vacuum work of the condensing engine is nothing more or less than the work exerted by the atmosphere as it falls back by gravity into the space vacated by the steam? Now an injector is simply a form of condensing engine, and to say that the condensation of the steam by 7.6 pounds of water (or any other proportion) will make the injector refuse to feed a boiler, is simply to deny that the feed apparatus on probably 30,000 boilers on the United States railways is in working order. Now what are the facts unobscured by a single bracket full of algebraic formulæ?

There is, we will say, a partial vacuum somewhere in the body of the injector. This vacuum space is open we will say to the boiler (check valve removed) and to a steam exhaust pipe. Hence into this partial vacuum water flows at a slow velocity, and steam flows *by virtue of its heat* at a high velocity, which is more or less closely represented by the formula given, as is admitted. Now I must tell Mr. Kinealy that this is when the steam does its work, and I must tell him that if each particle of hot steam (none the hotter, by the way, for having expended part of its own heat in getting into rapid motion) be cooled while it is traveling, it will continue to move forward just as fast as it was moving before it died, it being a law of motion that a body in motion will continue to move forever until stopped by an external agency. We have thus, in place of a jet of quickly-moving steam, a jet of as quickly-moving water, and it is by this moving jet of cold water that a further stream of cold water many times the weight of the working jet is forced into the boiler against the stream which would flow out but cannot do so in face of the superior energy of the injector stream. I never pretended to give correct equations. If any one wants these, I would refer them to the columns of an English mechanical paper, in which they have been lately appearing in all their algebraic glory, and which are perfectly unintelligible to 999 out of every 1,000 of the readers of that journal, while for the odd man out, who understands them, they are useless, for he can do it all himself.

Mr. Kinealy is right when he says the theory of the injector is simple and easily understood, but I beg to differ from him when he says his equations explain, etc. They do not explain the action of the injector to the bulk of men who have not a specially mathematical bent of mind. Indeed, they have failed to explain the action of the injector to Mr. Kinealy himself, or he would never have written the last few lines on the first column of his letter, for he would have perceived that they constituted a direct denial of the possibility of an injector working at all. One thing we know, the injector does work (I have ascertained this by inquiry from a man who monkeys with a locomotive.) We know also that the exhaust injector works against 70 pounds, and will feed water at 190°, taking steam from an open-ended exhaust pipe. I may add also that the colder we use the water supply which condenses the working steam the better it will act; and I guess it would puzzle Mr. Kinealy to make an injector work if he had much steam uncondensed beyond a certain point. The heat of the steam does its work in the supply pipe, and when the steam reaches the combining cone it is moving at a high speed, and if not sharply killed will stop the injector. I do not know if Mr. Kinealy has ever seen a pail of water thrown on a kicking injector to help it start. Were we to use a powerful force pump, and therewith force a fine jet of water through a small orifice into a wide converging cone like the parts of the injector, we should find that this jet would carry forward much other water and enter the boiler exactly as if the fine jet had received its velocity by reason of having been hot steam before it became water. Right in the body of the injector itself the work is not done by steam at all, for steam is the one thing we don't want in the injector past the combining cone. The so-called explanatory equations, if put into plain English, merely tell us that so much heat in so much steam

can be made to do so much work. They do not tell the practical man anything which explains to him by what series of actions it has become possible to take waste steam from a non-condensing engine and use it to push water into a boiler at 70 pounds. Had they been sufficient to do this I would have sent such a formula and saved space by occupying a couple of lines only.

I have been much interested by the information given this week (April 13) on the "Performance of Injectors." I see that one injector worked with as little water as 8.184 times the weight of steam used. An interesting point is raised in that so long as one injector will work it should be kept at as low an efficiency as possible, for it cannot waste heat. Everything gets into the boiler. This is specially the case with the exhaust injector, the object of which being to save otherwise waste steam, it is well to use as much steam as possible to do the work of feeding the boiler, and not to try and have a little steam do a lot of duty, whereby the feed would be so much colder.

From the fact that injectors will lift their water by suction, we may dogmatize on there being a partial vacuum somewhere inside them, or the water would not rise into them, or to be exact, be raised by the outside air pressure. The thus proved fact of there being a partial vacuum proves also that the working steam must have ceased to exist as steam at such point. All this, I think, goes to show that my explanation was not so totally wrong after all. Anyhow, if I am wrong it is only from to-day, and all the machinists in America will be busy next week putting pumps onto the locomotives. Would it not have been better if Mr. Kinealy had attempted a better and real explanation in place of trotting out the hackneyed thermodynamic equation of the text-books?

W. H. BOOTH.

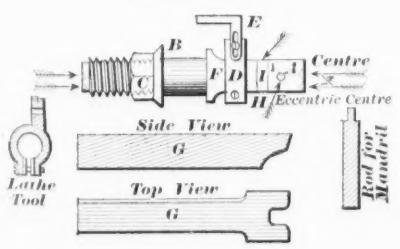
Mr. Dayton's Feeding Device.

Editor American Machinist:

I have noticed the mechanical contrivance of Mr. Dayton in AMERICAN MACHINIST of May 4, page 7, illustrated, and am especially interested in it for the reason that about 20 years ago I used the same in a thermometer graduating machine then invented and designed. It was used to feed the thermometer plate along while the degree marks were being put on to form the scale of degrees. In that case a nut was employed for the screw, which was double-threaded, and the cam collar was double-cam shaped, and inclined in cam surface to just match the screw thread, so that the nut would stand still about two-thirds the time, and then move for about a third, the nut thus advancing impulsively.

Let us hear from others who may locate this movement at still earlier dates.

S. W. ROBINSON.



Cutters for Gear Cutting.

Editor American Machinist:

Having read the article "A Question," by Greko, in your issue of April 20, 1893, saying he was informed that gear cutters can be accurately kept to size or form even though three-quarters of the tooth be ground away, but that he could not see how this is possible, as side clearance is necessary in addition to that obtained from the eccentric forming of the teeth, I can't see where he needs any more clearance than what an eccentric mandrel can give him, or how it can alter the form in grinding the cutter if the cutting edge of each tooth leads to the center of the cutter and not ahead of the center as is frequently the case. Each tooth has the same radius which will give enough clearance if a cutter is to be (commonly called) backed off after being slotted through in the milling machine. If it is then put on an eccentric arbor or mandrel with a center $\frac{1}{4}$" eccentric you can get any amount of clearance desired with a tool made to the required shape.

A cutter with clearance obtained in this way will, when the tooth that is cutting travels past the center, give instant relief. I inclose a sketch of an arbor which I use when there are no special tools made for the purpose.

A is a screw arbor or threaded mandrel fitted with nut *C* and flange *B*, the flange *F* being solid on the arbor. *D* is a split collar with adjusting spring or gauge for setting cutter at the proper radius and *G* the forming tool used in tool post in lathe. This is a very cheap way of making cutters that you grind and not alter the shape or width.

Schenectady, N. Y. A. A. ROLAN.

Strength and Horse-power of Gear Teeth.

BY BELL CRANK.

A simple rule for determining with considerable accuracy the horse-power of gear wheel teeth is certainly a desirable thing, as is shown by the fact that so many different ones have been formulated and come into use. Competent engineers who have investigated them closely find that none of these handy or simple rules are reliable enough to be used under all conditions. This is due mainly to two causes. First, all the rules take either the pitch or the thickness of the tooth at the pitch line as a factor. This is clearly wrong, for it has been shown by experience and by calculation, that a twelve-tooth pinion on the cycloid system, with radial flanks, has a little more than one-third the strength of its mating rack tooth. This shows that the strength of the tooth bears a kind of ratio to the number of teeth in the wheel. Second, all the rules have a fixed factor of safety. The factor of safety that is the best depends entirely on what the gearing is to be used for, and may vary from 3 to 15. A general rule should give the horse-power developed by the full strength of the tooth, and then a factor of safety may be used to suit the case in hand. In fact any designer who uses a formula for calculating strength of parts, without knowing the factor of safety employed, is taking an unwarranted risk. It would be much safer if all general rules were arranged to give the breaking strength only, and then consider the factor of safety as a distinct subject.

In addition to the foregoing, if we consider the difference in quality of material used, and also that there may be from one to several teeth in contact at one time, it is no wonder that we find such a variety of formulas for gearing, so that it is easy to find a formula to fit any size gear that may happen to be used in a given case. A good mechanic with some experience in using gearing can guess the horse-power much nearer than he could get it by the average formula in use. I will present for consideration and criticism formulas for the horse-power of gear teeth, which I think will be free from at least two of the foregoing faults, be more accurate than others and almost as simple as any.

The calculations are based on the interchangeable cycloid tooth, made with a generating circle of a diameter equal to one-half the pitch diameter of a 12-tooth pinion. Thickness of tooth at pitch line .47 of circular pitch. Addendum .3 of pitch. Pinions of 16 teeth or less have a fillet at bottom of flank with a radius equal to the bottom clearance. Wheels of 12, 14, 16, 20, 24, 32, 40, 80, 120 and rack were laid off accurately to a 2-inch pitch. Parabolas were then constructed on the tooth of each wheel, that would just touch inside the outline of the tooth, and the base of the parabola was taken as the depth of a beam equal to the weakest part of the tooth. 7,500 pounds was taken as the load to break a bar of cast-iron 1 inch square fixed at one end, and the load applied 1 inch from point of support. With these factors the force required to break the tooth was calculated for each wheel and the rack tooth.

The result showed that the rack tooth was 2.81 times stronger than the tooth on the 12-tooth pinion, and the tooth on a 20-tooth wheel was almost double the strength of the 12-tooth.

I then worked out a formula in which the number of teeth in the wheel is made a factor in such a way as to produce results that are more nearly in accord with the actual tooth strength.

EMERY WHEEL DRESSERS.

The factors are represented by:

p = circular pitch in inches.
f = face in inches.
n = number of teeth in wheel.
v = velocity at pitch line in feet per second.
d = diameter of pitch circle in inches.
r = revolutions per minute.
s = factor of safety.

No. 1. (For 12 to 24 teeth.)

$$\text{H. P.} = \frac{p\,v\,f\,(n-2)\,.33}{s}$$

or

$$\text{H. P.} = \frac{p\,f\,d\,r\,(n-2)\,.00144}{s}$$

No. 2. (For 25 to 120 teeth and rack.)

$$\text{H. P.} = \frac{p\,v\,f\,(n+340)\,.0205}{s}$$

or

$$\text{H. P.} = \frac{p\,f\,d\,r\,(n+340)\,.00009}{s}$$

I found it necessary to use two formulas, because it seemed impossible to make one cover the ground with sufficient accuracy. I also found it desirable to limit the greatest number of teeth in No. 2, because of the slight difference there was in strength between the higher numbers of teeth and a rack, but the increase in strength from 120 teeth to a rack is less than 5 per cent., and is therefore not a serious error.

A formula using the same strength for cast iron, but considering the thickness of the tooth at pitch line only, would be,

$$\text{No. 3, H. P.} = \frac{p\,f\,v\,4.12}{s} \text{ or } \frac{p\,f\,d\,r\,.018}{s}.$$

The most serious error is in formula No. 1, which gives a 14-tooth pinion 12 per cent. greater strength than the actual, but formula No. 2 is very close to the actual strength.

Calculating gear teeth, 3 inches p, 7 inches f, 10 feet v, s 10, n 12, we get 69 horse-power.

With n 24 we get 152 horse-power; n 60 we get 172 horse-power; n 120 we get 198 horse-power.

Calculating the same by formula No. 3, we get 86 horse-power, which would be a factor of safety of 8 for the 12-tooth pinion, and 23 for the 120-tooth wheel.

It is quite evident that almost any sort of a formula would hit a bull's eye somewhere between these two extremes.

By the use of the improved formulas we may do away with this wide variation in results, but we will yet have some factors which will be uncertain. The most important of these is the variation in the strength of cast-iron. Another is the injury to cast-iron caused by impact, which may be produced by sudden changes of load or badly shaped teeth. By way of caution in using these rules I would mention that gearing may be strong enough and yet the pressure between areas of contact be so great as to cause rapid wear, and also the speed may be so high that part of the strength of the tooth will be needed to resist centrifugal force.

As to a factor of safety, I think I cannot do better than quote from Mr. Wilfred Lewis: "For slow and harmless gearing where no serious results can ensue from breakage as low a factor as 3 may be used, but where high speed and great risk demand absolute security 12 or even 15 may be used."

It appears from this that the factor of safety used is mostly a matter of good judgment based on an approximate knowledge of the conditions under which it will work, and it is for this reason I prefer to use the formulas in the shape I have given them.

Fred J. Miller's Success.

A FORMER WORKMAN UNDER MR. CHAS. A. BAUER HONORED.

The remarkable manner in which talent of every kind is drawn to New York City is exemplified in the rise of Fred J. Miller, formerly a popular young mechanic of this city, to a position as associate editor of the AMERICAN MACHINIST, of New York. Mr. Miller worked for years in Springfield in the Knife and Bar Works, and afterwards had charge of a department under Mr. Charles A. Bauer at Lagonda. While in this city Mr. Miller wrote articles for the AMERICAN MACHINIST, of New York. So well were the managers of the paper pleased with his work that when the associate editorship of the paper was vacant they sent a man from New York to engage Mr. Miller for the place. He finally accepted, and was successful from the start. It is now announced by the Scribners that Mr. Miller has been engaged to furnish a paper on "The Machinist," for a series of practical articles which they are about to publish under the title of "Men's Occupations." As none but the leading specialists of New York City have been employed to write the various papers, it is a great honor to Mr. Miller, and it is one of which his Springfield friends may well be proud.—*Springfield [Ohio] Republic-Times.*

[It is only an act of justice to Mr. Miller to state that the above is published during his absence, and without his knowledge or consent.—ED. A. M.]

Emery Wheel Dressers.

We show with this a line of emery wheel dressers made by the Norton Emery Wheel Company, Worcester, Mass. The variety is found desirable for different sizes and qualities of wheels, and for a similar reason the different styles are made in different sizes, and to be used as hand tools or in a lathe, according to circumstances. The construction of these tools is shown by the engravings.

A manufacturing concern asks us who makes a jig saw for metals. If any of our readers know, we will thank them if they will give us the information.

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Headquarters at the Fair.

During the continuance of the Chicago Exposition the AMERICAN MACHINIST will have its headquarters in the space allotted to the Mechanical Press in Machinery Hall. The exact location is Section No. 27, Column K 37. Word can be left with the attendant there by any one who is desirous of meeting a representative of this paper, who may at the time be engaged elsewhere on the grounds.

Two New York State Laws.

The bill which has recently received the sanction of Governor Flower, thereby becoming part of the weekly payment law, extends the scope of this law very considerably. As the law now stands all joint stock companies are included. Not only this, but the law provides in addition to weekly payments of wages that a company cannot make an offset against wages of goods purchased on credit at company stores. This would be a good thing if it put out of existence such stores, especially in the mining districts, where, practically without competition, any prices can be charged workmen for goods sold on credit, the result being that the workmen—nearly all of them—are hopelessly in debt to the company, owing in a large degree to the outrageous profits extorted on goods sold them. The rigid enforcement of this law would help greatly in lifting the mine workmen to a higher plane, putting them to that extent out of the power of greed. They would learn the salutary lesson of earning their money before they spend it, and would be forced into the use of their reasoning powers more than—as a whole—they do now. The very manner in which they are compelled—too willingly perhaps—to live has a tendency to prevent the use of their better powers, and prevents the cultivation of the higher faculties. Always in debt to the companies, they come to look for some one else to deal out to them the food they eat and the clothes they wear, thinking of nothing but to day.

Whether the law will be enforced, that is, whether some way will not be found to evade it, is in doubt. If the workmen themselves are honestly in favor of its enforcement, and work to that end, it will no doubt be found efficient, or can be amended so as to be so, if it is not so at present. But if from lack of reasonable ambition to better their condition they would sooner remain in debt to their employers than to exert themselves to become free; if they had rather things remain as they are than make a temporary sacrifice for the sake of future advancement, the law will fall dead. As it is now, as is well known, the workmen are practically compelled to trade at company stores. Men are not wanted who will not do so. The sort of trade that comes to the companies in this way is too valuable to be lost. But if the workmen do not conspire with employers to keep up this state of things it can hardly be kept going.

On general principles we do not believe in laws that interfere between employers and employes. They have a contrary effect to the bringing about a feeling of independence. But on the other hand, in the present state of society, such laws, it has been abundantly shown, are in some instances necessary. When this is the case it is the necessity for the law, and not its existence, that is to be deplored. All men ought to be able to take care of themselves so far as making bargains are concerned, but unfortunately, if from nothing else than sheer weakness, they are not. It is a fact that the more intelligent men become the less need there is for such laws, but there are yet a good many who need to have some kind of a foothold prepared for them, from which to work along up in the way of intelligence. Such a law as has been referred to is at the best no more than a temporary expedient, but temporary expedients are sometimes important. While all will admit that the condition of workmen should be such as to enable them to demand and compel justice, it is a fact that there are bodies of producers that, almost to a man, are not in this condition. If this law helps them to become more independent it will be a good thing for every one.

The other law to which we refer is the new law making it a misdemeanor for any one to enter into a combination or trust whereby the natural operation of supply and demand shall be interfered with to increase the price of the necessities of life. This is another law difficult of enforcement. It has been shown time and again with what comparative ease breadstuffs and other articles necessary to life could be "cornered," the only satisfaction in the matter being that those who essay to do the cornering are some times, in the end, cornered themselves. But this is, of course, poor consolation to the people who have to furnish the money in any case, and are not particularly interested which set of rogues finally get it.

The main hope of the enforcement of this law is that so many are affected. But here again the poor are the principal sufferers. They have no way of "getting even" by raising rents or by some equivalent means; and, of course, by any methods ordinarily practiced the poor are the least able to see that the law is kept alive. Laws similar to this one have very generally been found practically valueless, and this for several reasons, one of which is that they are frequently purposely so drawn as not to be capable of efficient use—passed for buncome. Another is that no one who is able is sufficiently interested to look after their enforcement, or it is made of interest to the proper parties to see that they are not enforced.

Either or both of the laws referred to can be enforced, or put in shape to be enforced, if the people take sufficient interest in the matter. But it seems to be so much easier to preach about "conspiracy" and "fraud" than to make even a little effort to suppress them that the benefit to be derived from their passage is doubtful. What will be done with them remains to be seen. They are in the interests of the people. The question is, do the people want them in a sufficient degree to see that they are enforced?

Not Sufficient Evidence.

The Evening Post takes Secretary Herbert to task for the manner in which he is assumed to be treating Commander Higginson of the "Atlanta," or at least permitting him to be treated. The *Post* is quite right in its strictures, if as it says: "The newspaper correspondents who hang around the department and collect its gossip are let loose upon him to hunt him down," but there is, so far as we can see, no evidence to that effect. Commander Higginson, it appeared at the time, delayed sailing as ordered, having made a requisition for boiler tubes for repairs, but was peremptorily ordered to proceed. Having been considerably longer than the time ordinarily required between two ports, the newspaper correspondents, or at least the correspondent of the *Times* insinuated that he had purposely delayed the passage of the "Atlanta" out of spite, or something of the sort. If, as the *Post* appears to believe, the Navy Department attachés, in the absence of a knowledge of the facts in the case, had any hand in inciting the attack on Commander Higginson, there is abundant room for censure, and if this attack has been made by the consent of Secretary Herbert, he must be—let us say—foolish. It would be evidence of a very small mind, one that would let bad temper run away with decency and justice, and could not fail, if followed to any great extent, to lower the standing of naval officers.

But it is wise, as all modern observation shows, to place a very low estimate upon newspaper correspondence, especially from Washington, and particularly when a correspondent claims to have "inside knowledge" of what is going on in some department. The "Reliable Contraband" of war times has an enduring hold on the Washington correspondents of the daily press, and gossip that has no foundation outside their brains fills space just as rapidly as facts. It appears to us much easier to believe that this accounts for the "news" in regard to the commander of the "Atlanta" than that there was and is an effort of the Naval Department to get him "written down" by some one willing to do it for so much a column. Secretary Herbert, or the department attachés, cannot be convicted upon the testimony as published. It is a matter—the manner in which naval affairs are managed—that particularly interests the people of this country in these times when they are paying roundly for a "new navy," and if the *Post* is right in its assumption, further evidence ought to be easily collected.

The New Rifle.

The apparent final triumph of the Krag-Jorjensen rifle and its adoption for use by the U. S. army, while it may be regarded as somewhat humiliating to us who pride ourselves upon our ingenuity and inventive ability, must yet, we think, be regarded as nothing more than the legitimate effect of the conditions which prevailed for a number of years past. It is entirely probable that if we had been for the past twenty years paying more attention to war matters and preparations for war than to any one thing else, while Europe had been giving her attention to other matters, we would have been far ahead in our development of implements of war, as we were at the close of our last war which ended nearly thirty years ago.

The new gun is said to be an improvement over former models of the same name adopted by foreign countries and to be the best shoulder gun in existence for army use, though this is and will be vigorously denied by rival inventors and manufacturers, as is to be expected.

It is thought that the new rifle will soon be under construction at the Springfield Armory, and that the army will soon be supplied with it. It is a magazine gun, firing a long bullet .3 inch diameter, the powder chamber being enlarged so that relatively great velocity and dynamic energy are given to the bullet, which combined with its relatively small wind resistance gives it a very flat trajectory, great range and great penetration.

The example set by the Pennsylvania and the Lake Shore Railroad systems is one which it is to be hoped will be followed by every road in the country. These roads have granted to each employe two weeks' vacation, with free transportation to and from the exhibition at Chicago for themselves and all their dependent families. The exhibition now going on at Chicago is one the like of which will not probably be again seen in this country within this generation, and every possible facility should be given to those who can ill afford the expense of visiting it to do so if possible. The railroads are in a position to render much aid to their employes in the matter, and it is to be hoped they will make good use of their opportunities for doing good in this direction. Every employe will be the better employe for the education which will come of a visit to such an exhibition as this.

The failure of the Aldine Hotel enterprise at Chicago is scarcely less unfortunate in its effect upon the Fair perhaps than was the suspension of the bank which had a branch at Jackson Park.

This hotel enterprise offered special attractions to intending visitors who should be trusting enough to pay a good portion or all of their hotel bill some months in advance, and it seems that a goodly number of people were induced to do this, some of these being now in Chicago endeavoring to find out what prospect there may be for recovering any portion of their money to be applied to the payment of other hotel bills or to be spent at home, where probably many of the victims will conclude to spend what they may be fortunate enough to recover.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(281) X. Y., ———, writes: Please give rule for reducing kilogrammes to pounds. *A.*—A kilogramme is equal to 2.20462 pounds avoirdupois; hence, by multiplying kilogrammes by 2.20462, the equivalent number of pounds will be obtained, thus 10 kilogrammes are equal to $10 \times 2.20462 = 22.0462$ pounds.

(282) E. N. E., Williamsport, Pa., writes: I am having trouble to make rubber bands stick on iron band saw wheels. Please give a receipt for a cement. *A.*—The following is recommended: Soak pulverized gum shellac in ten times its weight of strong ammonia. This will make a slimy mass, which, if left to stand for a few days, will become liquid and ready to use.

(283) A. L. K., Lancaster, Pa., asks: Where can I obtain a book treating on engraving watches, jewelry, etc., and what is the price of it? *A.*—Write to any dealer in technical works, the address of some of these you will find in our advertising columns. 2. Is engraving a good paying trade? *A.*—It pays as well as any other profession in which skill, taste and experience is required.

(284) K. P., Jamestown, N. Y., writes: I have seen a clock dial whose face gave a light enabling one to see what time it was no matter how dark the room may be. Kindly inform me how such dials are made, and the chemicals employed for making them. *A.*—For this purpose a luminous paint is used, which is made by heating powdered oyster shells and sulphur together in a closed crucible. This forms a polysulphide of calcium, which is mixed with mastic varnish to form the paint. The polysulphide of calcium has the peculiar property of emitting in darkness light which it has previously absorbed. The practical application of luminous paint is limited, as the light emitted is small, and has failed for many purposes for which its use has been suggested. For match safes, clock dials, and under a few special conditions, it may be satisfactorily applied.

(285) W. E. T., Rutland, Vt., writes: I found by an omission on my part that the problem I gave you was not what I wanted. I should have stated it thus: A tank 24½ feet long and 61 inches in diameter is laid on its side in a horizontal position. Now, what I want is the contents for every ¼ inch in depth measured vertically downwards. *A.*—To compute this you will have to find the areas of segments, each increasing ¼ inch in height, and then multiply these areas by the length of the tank. If these areas are computed in square inches, they should be multiplied by the length in inches, the result will be cubic inches. The rule for computing the area of a segment is given in answer to Question 221 in our issue of May 4, current volume. This rule involves considerable labor which can be avoided by the use of the table of areas of circular segments given in Trautwine's Civil Engineers' Pocket-Book.

(286) R. D., Cleveland, Ohio, writes: Please inform me how the top of a copper fire box is fastened to the crown sheet. *A.*—The crown sheet is riveted to the sides and ends of the box. 2. What means are used to prevent the tubes at the fire box end from leaking? *A.*—To avoid leakage as much as possible copper ferrules are inserted between the tubes and the sides of the holes in the tube sheet; the tube is then beaded over to prevent the ferrule from dropping out, and at the same time protect the ferrule as well as the end of the tube from wear caused by the impact of the unconsumed fuel which is drawn against them. When ferrules are used, the holes in the tube sheet are drilled $\frac{1}{16}$ inch larger in diameter than that of the tubes. The outside of the ferrule is turned straight, and the inside is bored out tapered. The length of the ferrule is about ¼ inch greater than the thickness of the sheet, and its greatest thickness is about ⅛ inch at one end, the taper bringing the opposite end to a knife edge. The ordinary way of forming the taper on the end of the tube so as to fit the ferrule, is to hold the tube in an upright position, and allow it to drop a few times into a die bored out to the proper taper. Sometimes the ferrules are bored out cylindrical.

(287) G. M. T., Peekskill, N. Y., writes: I inclose sketches of two styles of disks to be used in a step bearing for heavy upright shafts, and I wish you would answer the following questions: Of the two styles of disks shown in Figs. 1 and 2, which is the more generally used? *A.*—Neither of them are often employed, because for a heavy shaft the brass disks are liable to break. Of the two styles we should prefer those shown in Fig. 2. 2. Which style will wear the longer? And will one be better lubricated than the other? *A.*—If the brass disks do not break, that in Fig. 2 will wear the longer because it will be better lubricated. 3. Will a U-groove give better results than the V-groove shown in Fig. 2? *A.*—There is no choice between them; in our opinion one will work as good as the other. For a step bearing which has to sustain a heavy weight, as indicated in your question, the design shown in Fig. 3 is a good one. The lower end of the shaft is shaped to a square,

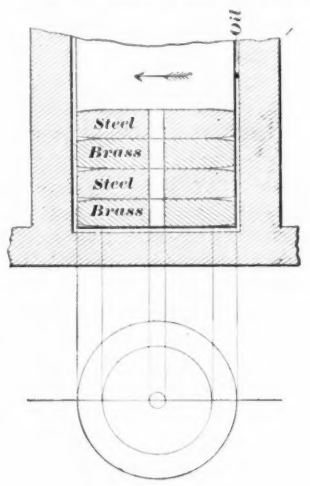


Fig. 1
American Machinist

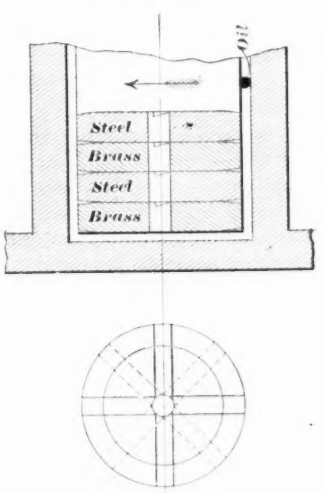


Fig. 2
American Machinist

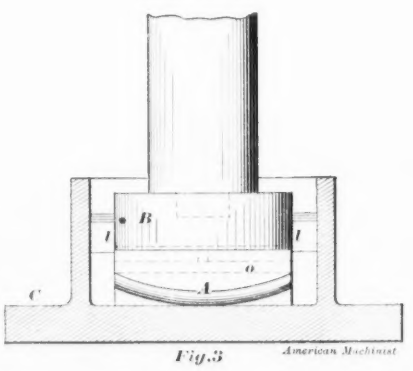
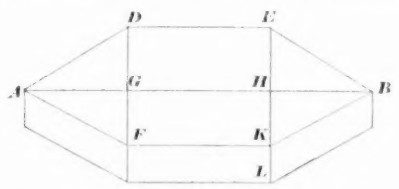


Fig. 3 *American Machinist*

which fits loosely into a corresponding socket in a cast-iron disk *B*, faced on its lower side, and provided with crossing grooves *l l* for oil. This disk abuts against a similar piece *A* of square horizontal section, turned true on top, and terminating below in a convex surface rocking on the bottom of the box *C*, in which the step is contained. The piece *A* is provided with a center hole met by others drilled from its periphery, which serve to convey oil to its center. The surrounding box *C* is filled with oil, which finds its way into the holes *o*, and is pumped up by the centrifugal action of the grooves *i l*, and distributed over the wearing surfaces, while the convexity of the loose piece *A* enables it to present a perfect bearing to the fixed disk *B*, and its square section prevents it from turning. If the velocity of the shaft be not excessive, and the pressure per square inch on the step be not over 50 pounds, the durability of the step will be practically endless. Under this pressure the disks never touch, but are constantly kept apart by a film of oil. Steps thus made by Messrs. William Sellers & Co., have been found, we are informed, after 25 years of constant running, still to show the tool marks of the lathe in which the wearing surfaces were turned up. In proportioning such a step, it is only necessary to divide the total weight to rest on it by 50, divide this quotient by .7854, and extract the square root of the quotient; the result will be the diameter of the disk. For further information on this subject, see Appleton's Cyclopedia of Applied Mechanics, from which the above has been taken.

(288) A. C., Houghton, Wash., writes: Please answer the following: With a boat of a certain length, breadth and draught, also the lines of the model duly considered, how do marine designers proceed to determine the power required to drive the boat a certain speed per hour, due allowance being made for skin friction, etc.? I am aware that this subject is an intricate branch, and has many varied, vexing conditions which must be solved, and for which due allowance must be made. But yet in this as well as all other branches of science there must be some elementary principles and stepping stones upon which successful boat designers depend. It is these elementary principles that I wish to become acquainted with. *A.*—The method of analyzing the forms of ships and calculating the indicated horse power, has been devised by Mr. A. C. Kirk, of Glasgow, and met with much favor on all sides. It is very generally used by shipbuilders on the Clyde and elsewhere for comparing the results obtained from steamers with those obtained from others, and likewise to judge of the form and dimensions of a proposed steamer for a certain speed and power. The general idea is to reduce all ships to so definite and simple a form that they may be easily compared. As rectangles and triangles are the simplest forms of figure, and more easily compared than surfaces enclosed by curves, so the form chosen is bounded by triangles and rectangles as shown in the accompanying figure. This is called a *block model;* its length *A B* is equal to that of the ship, and the depth *K L* is equal to the mean draught of water, the capacity is equal to the displacement, and its area of section equal to the area of immersed midship section of the ship. The dimensions of the block model may be obtained by the following methods:



A G is equal to *H B*, and *D E* is parallel to *F K*. Therefore the area *A D E B K F* equals *E K* × *A H*. The volume of the figure is this area multiplied by the height *K L*, and consequently the volume of the block is equal to *K L* × *E K* × *A H*. But *K L* × *E K* is equal to the area of the midship section of the ship, and the volume of the block is equal to the volume displaced by the ship. Hence, displacement × 35 = immersed midship section × *A H*. We also have, *E K* = immersed midship section divided by mean draught of water. It has been found that the wetted surface of this block model is very nearly equal to that of the ship. In actual practice the wetted skin of the model is from 2 to 5 per cent. in excess of that of the ship; for all purposes of comparison and general calculations, it is sufficient to take the surface of the model. For ocean-going merchant steamers whose speed is from 14 knots upwards, the length of *H B* is from .3 to .36 of the length. For ocean-going steamers whose speed is from 12 to 14 knots the length *H B* is from .26 to .3 of the length. For cargo steamers *H B* is from .22 to .26 of the length of the model. The length of the model is measured from the foreside of stem to the aft side of bodypost on the water line. To find the indicated horse-power from the wetted surface in ordinary cases, where steamers are formed to suit the speed, as indicated above, the number of horse-power per 100 feet of wetted surface may be found by assuming that the rate for a speed of 10 knots is 5, and that the quantity varies as the cube of the speed. For example, to find the indicated horse-power necessary to drive a ship at a speed of 15 knots, having a wetted skin of block model of 16,200 square feet, we have,

$$\text{The rate per 100 feet} = \left(\frac{15}{10}\right)^3 \times 5 = 16.875,$$

and the required indicated horse-power = $16\,875 \times 162 = 2{,}734$. When a ship is exceptionally well proportioned, the bottom quite clean, and the efficiency of the machinery high, as low a rate as 4 horse-power per 100 feet of wetted skin of block model may be allowed. 2. Could you name some suitable work on this subject for novices? *A.*—Manual of Marine Engineering, by A. E. Seaton, we believe is the highest authority on this subject. The above has been taken from this work, but considerably condensed. 3. Please give formulas for computing diameter and pitch of propeller. *A.*—This subject is very intricate, and will require too much space in these columns to explain it. For this information we must refer you to the above mentioned work. 4. Please give formulas for computing the dimensions of boiler suitable for the boat. *A.*—You will find this information in our answer to Question 246 in our issue of June 13, 1889.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's gears, Lex'n, Mass., & Phila., Pa. See p. 11.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

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De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Machinery of the New Composite Gunboats.

The design of this machinery, while not presenting a radical departure from existing practice, nevertheless contains some novel features which will be of great interest to all engineers, as it is believed to be a design which combines in an unusual degree all the good points which have been desired hitherto in naval machinery without the sacrifice of any. As is well known, there has been considerable complaint in previous designs because the machinery, while capable of driving the vessels at high speed when working at full power and under forced draught, has not been very economical at low powers, on account of the fact that the engines, designed for full power, were enormously too large for the power which they developed when working at cruising speed.

Various methods have been adopted to meet this problem, one of which is that in the "New York" and the "Brooklyn," of

having two independent triple-expansion engines on the same shaft, so that at reduced powers one of these could be thrown entirely out of use, and the ship driven with the after engine of each shaft, which would then be practically at about half its full power.

While this is an excellent design for machinery of great power, like that of the "New York" and the "Brooklyn," it is manifestly not applicable to a small ship.

Another method is that adopted for the two 'Pirates," the "Columbia" and the "Minneapolis," which have three engines of the same size which will all work at full power, while for reduced speeds the central one only will be used, the propeller shafts of the others being disconnected from the engines.

Still another method is that adopted on the "Maine," where the low-pressure cylinders are placed forward and arranged to be disconnected when working at reduced powers, so that the engines will then be compound, and the pressure, of course, will be that appropriate to a compound engine.

The method adopted in the gunboats is a development of that adopted for the "Maine." The engines will be quadruple-expansion at full power, working with steam of 250 pounds pressure, while they will be triple-expansion for cruising speeds, working with steam of 160 pounds pressure. This is accomplished by having two sets of boilers—four tubulous boilers to carry 250 pounds pressure, and two cylindrical boilers to carry 160 pounds. And it is just here that the especially novel feature of this design comes in. All the boilers will be used when the engines are working at full power, but the coil boilers will supply steam directly to the high-pressure cylinders, while the cylindrical boilers will deliver their steam to the first receiver, where it will meet the exhaust steam from the high-pressure cylinders at the same pressure, namely, 160 pounds.

The intention is, in general, to use the cylindrical boilers with the triple expansion arrangement, for cruising speeds, but it is perfectly feasible to use the coil boilers as well, and this will probably be done in order to give them a fair share of the work. There are twin screws, each driven by a separate engine, with cylinders eleven, sixteen, twenty-four and thirty inches in diameter by eighteen inches stroke, and it is expected that the horse-power will be about seventeen hundred and sixty when the engines are making three hundred revolutions, giving the ships a speed of fourteen knots; the cruising speed is expected to be about eight knots, with one hundred and sixty revolutions. When running at cruising speeds, the low-pressure cylinders will be disconnected, a very simple and efficient disconnecting coupling being fitted on the crank-shaft between these cylinders and the second intermediate. It is import ant to note, in this connection, that the three smaller cylinders which form the triple-expansion engine, are designed with special regard to highest efficiency when so used. The large low-pressure cylinder, which becomes the last one in the quadruple-expansion engine, has been designed so as to give fair economy, and a good distribution of steam when the engine is working at full power, but, as has been stated already, the primary idea has been to have the cruising arrangements designed with special regard to efficiency, as the engines will be used that way, probably nine-tenths of the time.

A matter which has been well understood by engineers for some time, but which was developed in a very clear and striking manner by Past Assistant Engineer Hollis in the *Journal of the American Society of Naval Engineers* for February, 1893, is the great reduction in the efficiency of the entire machinery at cruising speeds when there is a large number of separate auxiliary engines for running the air pumps and other auxiliaries. With this in view, the air pump has been designed to work from the main engine in the gunboats. It is, however, generally the case that air pumps, when working at high speed, as will be necessary for full power, are not as efficient as at lower speeds, so that there will be a diminution of vacuum. To obviate this, a small independent air pump will be fitted, which will be used for working on the condenser when the main engines are idle, and will also be used on the condenser to assist the air pump when working at full power. At cruising speeds, however, the only air pump will be that driven by the main engine, and which, at the speed then developed, will be thoroughly efficient.

Another good feature is the fact that the evaporators have been designed as an integral part of the machinery. Hitherto they have been located after the main engines were placed, and it frequently happened that the only place where they could be put was at some distance from the main engines. In the gunboats the evaporators will be in the engine room, and just alongside the condenser, so that the water fed to them for evaporation will be the discharge water from the main condenser, which will have been heated already some thirty or forty degrees above the temperature of the outside water, thereby giving a direct saving of that much heat; the discharge of the evaporators will go both to the main condenser and to the distillers. When going to the former it will be used to make up losses of feed water, so that the boilers will always be fed with fresh water, if desired.

The arrangement of the boilers is somewhat similar to that on the "Monterey," which also has four tubulous and two cylindrical boilers. As already explained, however, the combination on the gunboats is somewhat different, in that the coil boilers are intended mainly to supply the high-pressure cylinders when working at full power, while the cylindrical boilers are to deliver their steam to the first intermediate cylinders. No special type of coil boilers has yet been decided on, and it is probable that the decision will be, as was the case with the "Ericsson," to let the contractors for these vessels select a coil boiler subject to the approval of the Navy Department. It is, however, settled that the coil boilers are to have one hundred square feet of grate surface, and four thousand of heating surface.

The two cylindrical boilers will be about seven feet eight inches in diameter, and ten feet long, each having a single corrugated furnace. The grate surface of each will be about twenty-one square feet, and the heating surface six hundred and seventy-five square feet, making the aggregate grate surface of all the boilers one hundred and forty-two, and the aggregate heating surface five thousand three hundred and fifty square feet.

These cylindrical boilers are splendid examples of scientific designing; every point which needs to be looked after about the boiler has received careful attention, and it has not simply been a problem to get a good amount of grate and heating surface in the least possible diameter, but to make a boiler which shall stand comparatively hard usage without injury, and in which it will also be possible to use salt water, if this should be necessary in an emergency. In other words, the facilities for cleaning and scaling the boiler have received just as much attention as the question of its strength. All engineers who have seen the designs are delighted with them, as it is evident that no boiler has ever been designed before which will be so easy to keep in good condition as will be the case with these cylindrical boilers.

It might not be out of place to add, as the question might arise whether it is judicious to supply steam direct from the cylindrical boilers to the first receiver, that, while this has never yet been done, it is only an extension of the arrangement which has obtained for some time, of exhausting from the auxiliaries into the receivers, and also of fitting steam pipes direct from the boilers to the receivers, so that, if the boilers made more steam than the engines could work off, when all steam went to the high-pressure cylinders, a part could be turned directly into the receiver. The difference is that the arrangement in the gunboats is thoroughly scientific, and designed with due regard to economy, while the other is simply an arrangement fitted to provide for possible mistakes.

It is, of course, impossible at this time to state just what economy at cruising speeds will result, but there is every reason to believe that it will be very great, and should approach very closely to that of economical merchantmen. In fact, it is expected that a horse-power will be obtained for an expenditure of from 1.6 to 1.8 pounds of coal per hour.

It is an impossibility in a naval vessel to fit the large boilers which have been put on some of the economical merchantmen where there is a ratio of heating to grate surface of seventy-five to one. In this case it is only about thirty-two to one, but the merchant steamer figures would make the machinery so heavy that it would be out of the question for a man-of-war. The engines of the gunboats will certainly be as economical as those of the merchantman, and the boilers will be nearly equal.

On the whole, Commodore Melville is to be congratulated on this latest of his productions. Ever since he has been in the Bureau of Steam Engineering he has been striving for the very best that could be obtained in designs, and while wisely conservative about adopting entirely novel schemes, he has been thoroughly progressive in adopting everything that has been sufficiently tried to warrant a belief in its success. He is always very generous, too, in giving full credit to his assistants for suggestions that they may make to him, and which are embodied in the designs. In fact, it is a part of his policy to surround himself with the brightest and ablest young men in the Corps, and to encourage them to bring forward any new ideas they may have. In this way the service gets the benefit of a number of very bright minds working on these difficult problems, and a body of men is being trained who will be ready to take the places of the older men when they are retired.

MACHINERY OF THE ALL STEEL GUNBOAT.

For this vessel, the design does not depart much from usual practice, as the full speed will be only about twelve knots, while the regular cruising speed in the rivers in rapid currents will probably be ten to eleven knots. This will be just about full power under natural draught, so that the conditions would not have warranted the design adopted for the composite vessels, which are to make long cruises.

However, barring the use of coil boilers and the disconnecting of one cylinder, the design preserves all the excellent features of the other gunboats.

The engines will be triple expansion and vertical, driving twin screws. The cylinders are 14, 21½ and 32½ inches diameter by 18 inches stroke, and are expected to make about 1,350 I. H. P. at 280 revolutions. There will be four cylindrical boilers of the same general design as for the other two boats, each having 23 square feet of grate surface, and 775 square feet of heating surface, or a total of 92 square feet of grate, and 3,100 square feet of heating surface. The working pressure will be about 180 pounds.

The points already mentioned with regard to the air pumps and evaporators are preserved.

This design is excellent in every way, but, as already stated, has not all the novel features of the other.

Perhaps one of the most serious blots [in British patent laws] is the inducement held out to inventors to conduct their own patent business. We do not say this in the interest of patent agents. The interests of so vast a number of persons as is comprised in what may, for convenience, be termed the general body of inventors, are, of course, infinitely more extensive and important than those of the comparatively very limited class composing the patent agents. If, therefore, it could possibly be of advantage to inventors in general to advocate the extension of facilities calculated to induce them to dispense with professional aid in taking out their patents, it would obviously be our duty to do so. But it would ill become us to advocate the encouragement of a course which experience has proved to be disastrous to the interests of a very large proportion of those who have adopted it.—London *Engineering*.

Fairbanks, Morse & Co. write us: "Referring to inquiry 247, M. C. M., Kansas City, Mo., we can supply him with all the chronometer valves he may require if he will call at 1310 Union avenue, Kansas City, Mo., or address us at that number."

The engineers of Chicago representing the N. A. S. E. have opened a Bureau of Information and Entertainment at 179–181 Lake street, and invite the engineers of the world to make it headquarters.

A correspondent is desirous of knowing who builds, for sale, a machine for making tooth picks. Perhaps some of our readers can inform him.

MANUFACTURES.

Graham, Gardner & Co. will erect a machine shop in Ocala, Fla.

The Scotland Neck (N. C.) Cotton-mills will add more machinery.

J. F. Powers and Geo. J. Corey will build a machine shop in Elkton, Md.

The John Peters Iron Co., Ironton, O., has been formed with capital $36,000.

Massachusetts parties contemplate locating a barrel-head factory at Skowhegan, Me.

At Galveston, Tex., the Astall Iron Works Co. has been chartered with a capital stock of $50,000 to operate iron works.

The Grand Rapids Brass Company, of Grand Rapids, Mich., will, it is said, build a three-story 60x100 foot addition to their works.

J. A. Fay & Egan Co., Cincinnati, Ohio, has received an order for wood-working machinery from Padano, Sumatra, Dutch East India.

Aderhold Mfg. Co., Birmingham, Ala., issue a cut and description of their feed water regulator, which they are placing on the market.

J. N. Kervin, M. Neil and R. W. Wilson have incorporated the Marlboro Hedge Fence Co. at Bennettville, S. C., with a capital stock of $20,000.

N. Lehmann Co., of Hamburg, N. Y., to manufacture boots and shoes, has been formed with a capital of $10,000. Directors G. C. Harderly and others.

The Norton Emery Wheel Company, Worcester, Mass., has issued a new catalogue of emery goods and grinding machinery. It is quite fully illustrated.

The Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, send us some leaves containing excellent illustrations of several tools which they manufacture.

The Gautier Steel Co., of Johnstown, Pa., have begun a building 50x290 feet in which to erect a 14-inch train of rolls for the manufacture of merchant steel. The building and machinery will be ready shortly.

The Taylor Engine Company, Chambersburg, Pa., issue three catalogues of engines, both throttling and automatic, fixed portable and semi-portable, also boilers. All the catalogues are illustrated.

Kunbal Brothers, of Lawrence, Mass., are to have a shoe factory erected for them in that city by a syndicate, according to local papers. The shoe factory is to be a four-story building, 200x50 feet in size.

The Southern Pacific Railroad Company's shops at Ogden, Utah, for which bids are now being received, include a 450x200-foot roundhouse, a 32x120-foot office and storage building and a 94x235-foot machine shop.

C. H. Perkins, of Providence, R. I., is putting up a four story building, each floor having about 13,000 square feet. It is stated that the power plant will be an 80 horse-power engine and two 75 horse-power boilers.

Strong inducements have been offered to the Birmingham (Ala.) Rolling mill Company to locate at Louisville, Ky., and as the owners of the company largely reside there, they have met with considerable favor.

The Rome (N. Y.) Locomotive and Machine Works has been formed to manufacture railroad locomotives, portable and stationary engines, cars, machinery, etc. Capital, $150,000, and directors, T. H. Strycker and others.

Articles of incorporation have been filed for the Los Angeles (Cal.) Iron and Steel Company, with a capital of $150,000. About one half the stock has been subscribed and paid, and the location for the rolling-mill selected.

E. G. Smith, Columbia, Pa., has issued a new catalogue of vernier sliding calipers, sheet metal gauge (micrometer), etc. The circular contains instructions for reading the vernier. Several testimonials are published.

The J. D. Smith Foundry Supply Company, Cincinnati, Ohio, send us their catalogue of molders' tools, which will be of interest to the trade, the illustrations being quite complete; also cut and description of exhaust tumbling barrels.

The Thomson Meter Company, Brooklyn, N. Y., has issued a very finely illustrated catalogue of water meters. The cuts and text show the construction and application of the meter very completely. In all respects the catalogue is a fine one.

The Capital Sheet Metal Company, of Columbus, O., has been chartered by E. M. Poe, W. L. McDonald and others. The capital stock is $100,000. The company was incorporated to carry on a general manufacturing business in addition to its specialty, sheet metal products.

The Worcester Consolidated Street Railway Co., of Worcester, Mass., have placed the contract for their new car house with the Berlin Iron Bridge Company, of East Berlin, Conn. The new building will be 95 feet in width and 200 feet in length, entirely of brick and iron.

The Indurated Fiber Company's mill at North Gorham, Me., recently destroyed by fire, is to be rebuilt at once. The loss has been adjusted at $5,000, and it is expected there will be erected a building large enough to accommodate the mill proper and the dry rooms.

The rolling mill of the Ellwood (Pa.) Steel Co., the erection of which was begun last August, will be put into operation in a few days. The main building is 115x160 feet, and contains all the necessary machinery, furnaces, etc. There are 4 pair furnaces and 4 sheet furnaces.

The Canyon Water and Power Company, of Ogden, Utah, has recently been incorporated with a capital stock of $250,000 by C. E. Mayne, David Hay, E. R. Ridgely, D. H. Adams and O. J. Stillwell, of Ogden; Nicholas Finzer, of Louisville, Ky., and W. A. Paxton, of Omaha, Neb.

Joseph Dixon Crucible Company, Jersey City, N. J., will send a card upon which is a cut and a letter from an engineer, showing a "homemade" arrangement for feeding lubricating graphite to the cylinders of steam engines. The device is very easily made from gas pipe. Write for card.

Jones & Laughlins, Pittsburgh, Pa., are making extensive repairs to their plant. The tin and plate-mill has been torn down and a continuous mill erected. The old nail factory will also be torn down and its place will be erected a 16-inch mill, which will be the second of its kind at these works.

The Keystone Engine and Machine Works, Philadelphia, Pa., are agents for the automatic safety stop for Corliss engines, or for engines of other types. This stop operates to shut off steam and stop the engine in case of accident. The device is described in a circular issued by the company named.

J. D. Taylor, Andrew Nicholson and others, of Cambridge, O., will soon commence the erection of a new sheet-rolling-mill to employ 200 men. Building grants have been given and a site selected. The Cambridge Iron and Steel Company, of the same place are erecting a galvanizing works to be 70x120.

The Frasse Company, 19 Warren street, New York, inform us that they are having good success in the introduction of their high grade of Austrian tool steel, also fine grade of files after the Grobet pattern, made in Austria. The Frasse Company recently removed from Park Row to their new quarters.

A corporation to be known as the Stevens Silver Company has been organized at Portland, Me., for the purpose of plating with gold, silver, nickel and other metals, dealing in britannic, gold, silver, nickel and other metals, with $20,000 capital stock, of which $150 is paid in. The officers are: President, Alfred A. Stevens, of Deering; treasurer, Martin A. Dillingham, of Portland.

There is water-works agitation at Berwin, Ill.; Webster, Mass.; Farmville, Va.; Ipswich, Mass.; Lebanon, O.; Bad Axe, Mich.; Bangor, Maine; Manchester, N. H.; North Creek, N. Y.; Jamestown, N. Y.; Newburgh, N. Y.; Rockville, Mass.; Newport, Maine; Galveston, Tex.; North Brookfield, Mass.; Columbus, O.; Ogdensburg, N. Y.; Madison, Wis.; Fostoria, O.; Spring Valley, Minn.

The Connersville [Ind.] Tool and Machine Company has started a new machine shop in that town, in which they propose to do jobbing machine work and manufacture some dental specialties, the invention of Dr. Morrison a member of the new company, the other leading member being Mr. Wainwright, who for some years past has been foreman of the machine shop at the Root Blower Works.

Articles of incorporation of two new companies have been filed in the Secretary of State's office, Hartford, Conn. One was the Waring Electric Co. with a capital stock of $5,000, divided into fifty shares of $100 each. The other company was the Frisbie Elevator and Manufacturing Co., of New Haven. The company is to manufacture and deal in elevators, machinery and electrical devices. The capital stock is $70,000

Thomas Carlin's Sons, Allegheny, Pa., have issued an illustrated catalogue of which they say: "In answer to the universal cry of 'Better Roads and Roadways,' and consequent *better sewerage*, we have issued this our 'F' catalogue, as illustrating our large and complete line of sewer castings, gutter crossings, etc., together with a partial list of road rollers, crushers and contractors' tools." This firm also issue a list of machinery in stock, such as engines and boilers, hoisting machines, pumps, yard locomotives, shears machine tools, and a large variety of other machines and machinery.

The Buffalo Forge Company, Buffalo, N. Y., has been awarded the contracts for the heating and ventilating plants of Christ M. E. Church, at Pittsburgh, Pa., and Calvary M. E. Church at Allegheny, Pa. These two churches are the largest of the kind in these cities. In every example of church heating and ventilating installed by this company, the apparatus is so built that it can be used as a cooling machine in summer, as well as a heating and ventilating plant combined during the cold weather. Arrangement is further provided that during the moderate weather, hot air and cold air can be mixed, and thus the ventilation is kept up without overheating the audience room. The machinery and materials employed in the heating and ventilating plant for the above buildings, constitute more than two carloads.

Machinists' Supplies and Iron.

NEW YORK, June 3, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.25; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $14.25 to $14.50 for No. 1 Foundry; $12.75 to $13.50 for No. 2 and $11.75 to $12.50 for Gray Forge.

Antimony—The market is steady. We quote L. X., 10¼c. to 10⅜c.; Cookson's, 10⅛c. to 10¾c.; Hallett's, 9⅞c. to 9.95c., and U. S. French Star, 10⅛c.

Copper—Some business is reported at 11c for Lake Copper. Inland trade is exceedingly dull. Casting Copper is held at 10c. to 10⅛c.

Lead—The market is dull, but prices are fairly maintained at 3.92c. to 3.95c.

Lard Oil—Prime City is quoted at 85c. to 86c.

Spelter—The market is nominal at 4.20c. for New York delivery. Production has been excessive for some time.

Tin—The market is dull and prices are lower. Sales are reported at 18.9c. for June, and 18.80c. for delivery in two months; 19c. is generally asked for the balance of this month.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Foremanship; engines, pumps or general jobbing. Indicator, AMERICAN MACHINIST.

Wanted—Position as foreman boiler maker; 12 yrs'. exp; ref. A1. A. M P., Box 92, Roanoke, Va.

Draftsman & M. E. (grad. in Europe) wants pos., 1st class refs. Box 143, AMERICAN MACHINIST.

Mech eng., grad of a European Polytech'l school, exp, wishes pos. as draftsman. L R., AM. MACH.

Draftsman (designer), mach. tools, jigs, fixtures, general mach'y, desires pos. H. M., AM. MACH.

Mechanical superintendent would like a situation. Best of references. Energy, Box 144, AM. MACH.

Wanted—Position by graduate and mech. draftsman, 10 yrs' exp. Box 148, AM. MACHINIST.

Wanted—Position as draftsman or assistant superintendent by 1st class designer. Ref., will be pleased to answer questions. Noxin, AM. MACH.

Wanted—Position as foreman in iron foundry. Ten years' experience. Best of reference furnished. Address Box 145, AMERICAN MACHINIST.

Pract. & progressive machinist (age 30) wishes to change about July 15. Pos. as foreman pref'd; for particulars, address "Keystone," AM. MACH.

Wanted—An assistant draftsman. Apply by letter to John Rohland, care of Coxe Bros. & Co., Drifton, Luzerne Co., Penna.

Wanted—Draftsman and machinist with tech. training desires a change. New York City pref'd. Address Box 138, AMERICAN MACHINIST.

Wanted—Permanent position as ass't foreman or draftsman, 10 yrs' prac. exp. in elevators, electric & steam pumps, etc. Address "S.", AM. MACH.

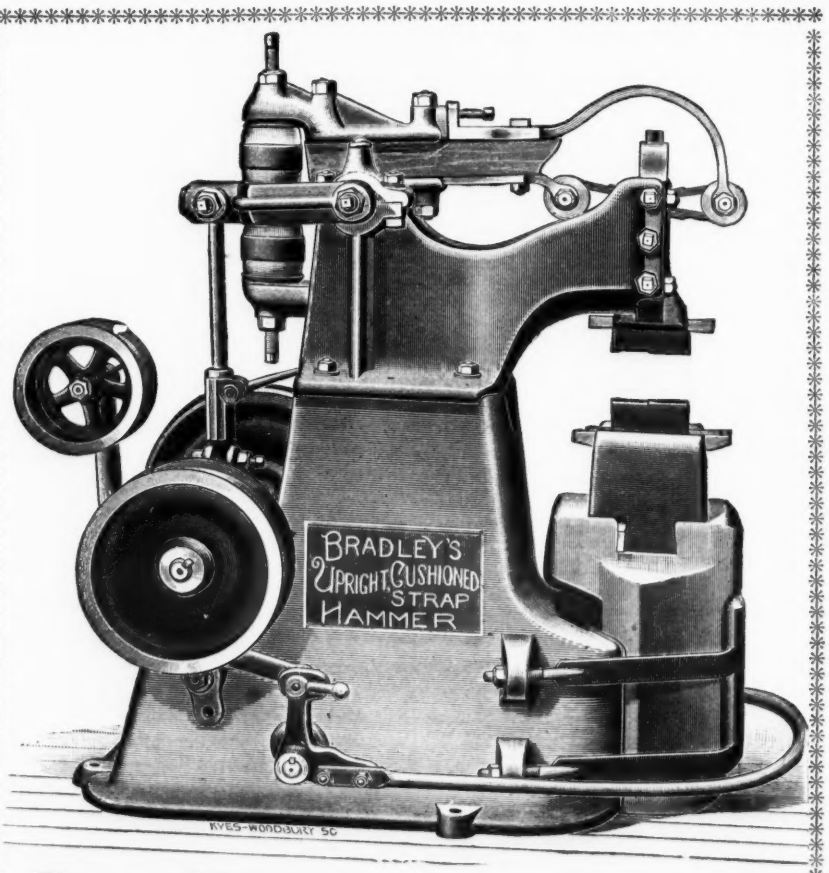
Wanted—Pos. at designing special metal working mach. and fixtures by mech. eng., or as supt.; age 35. Faithful, AMERICAN MACHINIST.

Wanted—Position as manager or superintendent with 1st class steam engine works, 25 yrs' exp. Address Engine, Box 141, AMERICAN MACHINIST.

Wanted—Pos. by a competent mach. A1 planer, 22 yrs' exp., 10 as foreman. New England pref'd. Address No. 10 High street, Ansonia, Conn

Mech. draftsman wishes a situation; well acquainted with machinery in general; refs. given. Address Box 147, AMERICAN MACHINIST.

(*Continued on page 12.*)



Bradley Hammers.

If you plate, draw, square, taper or weld iron and steel, you need a Bradley Hammer.

If you swage, collar, spindle, or do any manner of die work, a Bradley Hammer will soon pay for itself.

That the Bradley is the best Power Hammer in the market has never been questioned. Our circulars illustrate, describe, give sizes and prices.

BRANCHES: 14 Warren St., New York. 96-98 Sudbury St., Boston.

BRADLEY & COMPANY, Syracuse, N. Y.

HAVE YOU A DEPTH GAUGE?

It is a very simple and invaluable little instrument. We sometime ago made some for the use of the machinists who work in our factory, and others who saw them wanted them. So we made up a few hundred, had them nickel plated and put the nominal price of 40 cents (post paid) upon the article. It is as well made as any instrument of its kind and if not satisfactory may be returned. The reason we sell this tool at such a price is in order to bring us into connection with engineers and machinists. This is why we publish our engineering books at cost price, which sell by the thousand.

Address, MASON REGULATOR CO., Boston, Mass.

Ready Made Cut Gears.
Ready Made Cast Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St.,
Philadelphia, Pa.

THE IRON FOUNDER,

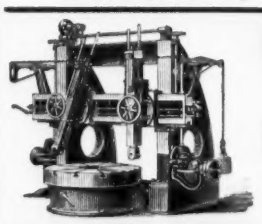
By SIMPSON BOLLAND, Esq.

300 Illustrations. 400 Pages. 12mo. Cloth $2.50.

JOHN WILEY & SONS, - NEW YORK.

CHAS. A. STRELINGER & CO.,
Tools, Supplies and Machinery,
DETROIT, MICH.

MACHINE DESIGNING, MECHANICAL DRAWING, Patent Office Drawing, Print Copies of all kinds and sizes. Lowest prices consistent with good workmanship. Correspondence solicited.
FRANK A. FOSTER,
Room 442 Butler Exchange, PROVIDENCE, R. I.



BORING AND TURNING MILLS
COMBINING EVERY IMPROVEMENT.
14 SIZES FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
WILMINGTON, DEL.
Chicago Office: 14 South Canal St.

H. W. JOHNS'

ASBESTOS SECTIONAL PIPE COVERINGS.

Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y. JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, ATLANTA, LONDON.

✻WANTED✻

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Designer and draftsman, tech. grad., 6 yrs' shop and 8 yrs' office ex. on steam and hydr. eng., transmission of power and structural iron work, wishes to change. Box 146, Am. Machinist.

Wanted—Position for July 1st by young mechanical engineer and draftsman, or at once charge of industrial concern at the World's Fair. Apply Box 135. American Machinist.

Wanted—1st-class vise and floor hands of large experience; must be sober and industrious. Can secure steady employment. Married men preferred. Morgan Engineering Co., Alliance, Ohio.

City or country. Expert helpers furnished without charge, for carpenters, wood carvers, and wood turners. Small pay acceptable at start. Address 225 E. 9th street, New York City.

Wanted—A young energetic draftsman who has had shop experience and is well grounded in first principles of steam & mech'l eng'g. Apply by letter only to Clark Thread Co., Box 154, Newark, N.J.

Bookkeeper—Young man, 30, experienced in the accounts of machine shop & foundry, desires some position of trust. Thorough business training. Highest references. Bookkeeper, Am. Machinist.

Draftsman (designer) wants pos., tech. graduate, 5 yrs' mach., 8 draftsman, and two had charge of drafting room (10 men). Exp'd on jigs and fixtures, light and heavy mach. tools, hyd. cranes, gen. mach'y. Box 140, American Machinist.

Wanted—A practical mach. or pattern maker who is a capable draftsman. One who has had some exp. in designing special machines and tools for making iron and brass valves, steam fittings, etc., pref'd. Address Box 139. Am. Machinist.

Wanted—Situation as supt. or foreman of machine shop, any class of work. Have had 20 yrs' exp., and have been in present situation on electrical work of every description for 12 yrs. Highest of refs. furnished. J. H., American Machinist.

Wanted—A foundry foreman; must be a man of experience who is capable of producing the highest class of machinery castings; cylinders a specialty; give references, age, experience and salary expected. Address Box 136, American Machinist.

Wanted—A few young men having had some machine shop practice can find steady employment at fair pay by applying with references to the undersigned; also two or three expert tool makers wanted. L. S. Starrett, Fine Tool Maker, Athol, Mass.

Young Norwegian, graduate of technical college in Norway and with some practical experience in ship designing in the navy yard at home, desires position as draftsman with a ship-building firm; salary moderate. Address Navy, Am. Machinist.

Wanted—A thoroughly practical and exp'd foreman, to take charge of a tool-room; design & oversee making of punches and dies, tools for milling & screw machines, etc. And supt'd the manufacture of small articles in large quantities, in very fine brass work. Exc't position for right man. Give age, exp.. etc., Thorough, Box 142, Am. Mach.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Punch & Drop Presses. Am. Tool W'ks., Clev., O.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Agents to sell sliding calipers, etc., liberal inducements. Address E. G. Smith, Columbia, Pa.

Monitor lathes 15" & 30" swing, $100 each. Screw cutting lathe 17" swing, $95. 229, Am. Machinist.

We will pay 25 cents each for copies of the American Machinist of December 4, 1886 issue; must be unsoiled and in good condition. American Machinist Publishing Company, 203 Broadway, New York.

SECOND-HAND MACHINERY.

SCREW-CUTTING LATHES.

1 15 in. x 8 ft. Jones & Lamson, Rise and Fall Rest.	Good order
2 15 in. x 6 ft. Flather, Rise and Fall Rest.	Good order
1 16 in. x 8 ft. Star Tool Co., Plain Rest.	Good order
1 16 in. x 6 ft. Reed, Rise and Fall Rest.	A1 order
1 17 in. x 6 ft. Fitchburg, Compound Rest.	Good as new
1 17 in. x 8 ft. Gray, Plain Rest.	A1 order
1 18 in. raised to 36 x 8 ft. Farmer, Plain Rest.	A1 order

PLANERS AND SHAPERS.

2 18 in Lathe & Morse Crank Planers.	A1 order
1 16 in. x 16 in x 3 ft. Belden Planer.	A1 order
1 20 in. x 20 in. x 4 ft. New Haven Planer.	A1 order
1 24 in. x 26 in. x 6 ft. Pease Planer.	Good order
1 16 in. x 16 in. x 6 ft. Pratt & Whitney Planer.	A1 order
2 15 in. Juengst Friction Shapers.	Good order
2 24 in Hendey Friction Shapers.	A1 order
2 10 in. Juengst Crank Shapers.	A1 order

MISCELLANEOUS.

1 No. 4 Stiles Power Press.	Good as new
1 No. 3 Stiles Power Press.	A1 order
1 No. 1 Brown & S. Universal Miller.	A1 order
1 No. 3 Brown & S. Universal Cutter & Reamer Grinder.	Good as new
1 No. 1 Brown & S. Universal Grinder.	A1 order
3 Slate Sensitive Drills.	A1 order
2 Barnes Friction Disk Drills.	Good as new
1 18 in. Pratt & W. Power Drill.	Good order
1 24 in. Dexter Drill, B. G., power feed.	A1 order

700 New and Second-hand Tools in stock. Write for complete list, Photographs and Prices.

THE GARVIN MACHINE CO.,

LAIGHT & CANAL STS., NEW YORK.

SECOND-HAND AND NEW MACHINERY

84x84x16½ ft. Planer. Niles Tool Works, three heads.

Planers.	62 in. x 22 ft.	Planers.	25 in. x 5 ft.
"	42 in. x 16 ft.	"	24 in. x 5&6 ft.
"	36 in. x 12 ft.	"	24 in. x 4 ft.
"	31 in. x 8 ft.	"	22 in. x 5 ft.
"	28 in. x 7 ft.		

80 in. x 18 ft. Engine Lathe Geared Face Plate.
60 in. x 45 ft. Double Engine Lathe.
52 in. x 35 ft. Engine Lathe Horizontal Boring Machine, one end.
30 in. x 28 ft. Pond Machine Tool Co. Shafting Lathe.
36 in. x 16 ft Engine Lathe.
34 in. x 27 ft. " "
32 in. x 12, 14, 16, 18 ft. Bed. New Engine Lathe.
28 in. x 22 ft. Engine Lathe, cheap.
25 in. x 12, 16, 20 and 24 ft. Bed. New do do
24 in. x 10, 12 ft. Bed. do do do
20 in. x 5, 6, 8 & 12 ft. do 2d Hand do do
18 in. x 6, 7 & 8 ft. do New & do do do
17 in. x 8 ft. do do do do
16 in. x 6 & 8 ft. do do do do do
15 in. x 6 & 8 ft. do do do do do
14 in. x 6 ft. do do do do do
Car Axle Lathe, Bement. | Driving Wheel Lathe 88 in.
15, 16, 18, 25 in. Crank Shapers. | Wheel Quartering Mach.,
20, 24, 26 & 30 in. Geared Shapers. | Double right and left hand.
20, 22 24, 26, 30 & 36 in Drills. | No. 0 Turret Lathe,
Bolt Cutters. | Am. Tool and Mach Co.,
8 and 13 in. Stroke Slotters. | 24 in. Swing, 8 ft. Bed.
Lot of Lincoln Pattern Millers and No. 1 P. & W. Millers.
3 Spindle Drills. Garvin.
Gear Molding Machine. Stamping Press, Bridgeport.
1100 and 3000 lb. Bement Steam Hammer.
100 lb. Steam Hammer. | SEND FOR
40 H. P. Vert. Engine. N. Y. S. S. P. Co. | MAY LIST.
11 in. x 18 in. Hor. Engine. A1 Order.
16 in x 42 in. Corliss and 16 in. x 48 in. Brown Eng.
300 H. P. Westinghouse Comp'd Engine.

GEO. PLACE MACHINE CO.,

120 BROADWAY, NEW YORK.

Flexible Metallic Fillet

For Pattern Makers. 8 Sizes.
H. WHITE, 44 N. 4th St. Phila, Pa.

MACHINE TOOLS

NEW AND SECOND-HAND.

ENGINE LATHES.

13 in. x 6 ft.,	Complete. Cpd. Rest and Cross Feed.	Improved style
14 in x 6 ft.,	do	Prentice, Hendey and Fitchburg
16 in. x 6 ft.,	do	Hendey Fitchburg and Prentice
16 in. x 8 ft.,	Improved style. Cpd. Rest and Cross Feed.	
18 in. x 8 ft.,	Complete, Horton's. Improved style. "New features."	
18 in. x 8 ft.,	do New heavy pattern.	Fitchburg
20 in. x 8–10 ft.,	do Cpd Rest and Cross Feed.	
21 in. x 10 ft.,	do do do do	Perkins
22 in. x 10–12 ft.,	do Improved style. Ex. heavy.	
24 in. x 12–14 ft.,	do do do	
28 in. x 16 ft.,	do do do	
30 in. x 18 ft.,	do Old style. Fair order. Cheap.	
96 in. x 16 ft.,	Triple geared, 84 in. Face Plate. Good order.	

PLANERS.

21 in. x 5 ft.,	Complete. Fair order. Price $1 25.	
22 in. x 5 ft.,	do with Chuck, Putnam.	
24 in. x 6 ft.,	do New Improved style.	
28 in. x 6 ft.,	do Putnam.	
28 in. x 6 ft.,	do Good order. Low Price.	
30 in. x 10 ft.,	do Modern style. Ex. heavy. A1. order.	
36 in. x 12 ft.,	Extra weight and power. Powell Planer Co.	

SHAPERS.

6 in.	Stroke, 22 in. Feed "Crank" Good order Cheap.	
8 in.	do Crank. Good order.	Gould
9 in.	do do Extra heavy.	Hewes & Phillips
13 in.	do do do Good order.	
14 in.	do do Trav. Head. Improved style.	Fitchburg
15 in.	do do "New Improved Style."	
20 in.	do do Ex. heavy. Good order.	
22 26 in.	do Triple Geared. Improved.	

MISCELLANEOUS.

Radial Drills, 3, 4, 5 and 6 ft. Arms. Improved.
Upright Drills, 20, 21, 25 and 32 ins. Prentice.
Upright Boring and Turning Mill 38 in. A1.
Brown & Sharpe Vertical Turret Machine A1.
Universal Milling Machine, Improved style. "New features."
Milling Machines. Standard sizes. Improved style.
Lincoln Milling Machine. With Vise. Good order.
Screw Machine 15-16 in. Back gears, Auto. feed, Chuck and Tools Complete, Jones & Lamson. A1.
Boiler Bending Rolls, 8-10 ft. "Improved style." Hinged housing

J. J. McCABE,

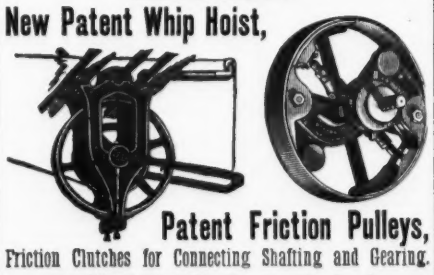
SUCCESSOR TO
E. P. BULLARD'S
N.Y. Mach'y Warerooms.

14 Dey St.,
NEW YORK.

VOLNEY W. MASON & CO.,

MANUFACTURERS OF

New Patent Whip Hoist,

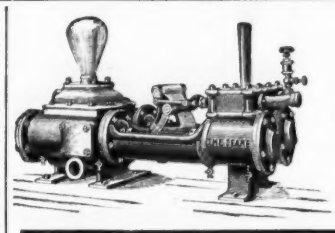


Patent Friction Pulleys,

Friction Clutches for Connecting Shafting and Gearing.

PROVIDENCE, R. I., U. S. A.

CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK



THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO.
PITTSBURG, CHICAGO, NEW YORK.

STEEL FOR Lathe and Planer TOOLS, Cold Chisels, Punches & Dies, Milling Cutters, Molding Bits, &c.

SHEET STEEL, POLISHED Drill Rods, SPRING STEEL, Machinery Steel, COILED SPRINGS, Steel Forgings, ETC.

A NEW SCREW PLATE.

THE HANDIEST PLATE MADE.

THE FULL MOUNTED LIGHTNING.

These Plates have a stock with each die. The dies are our celebrated Adjustable **Lightning** Dies. Each Stock is of correct length and weight to suit size of die. Several sizes of dies may be in use out of same set at same time. SEND FOR CATALOGUE. Made by

WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

"R. MUSHET'S SPECIAL STEEL"

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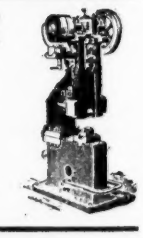

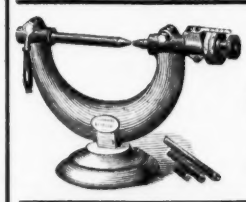

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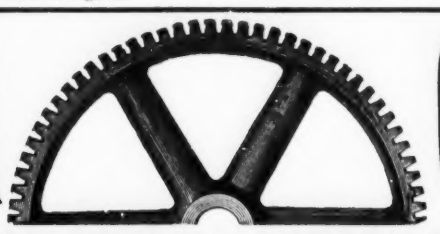

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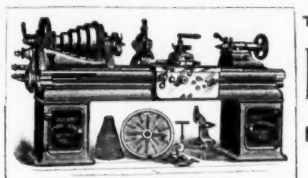

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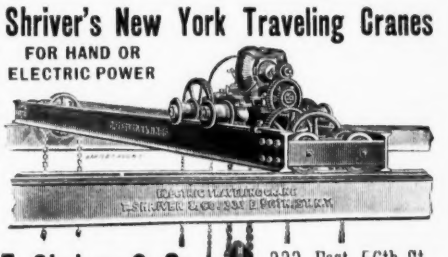

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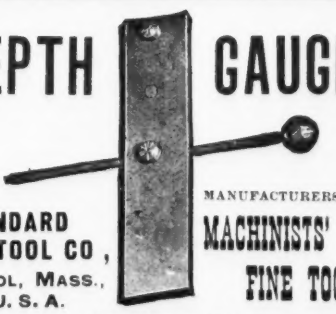

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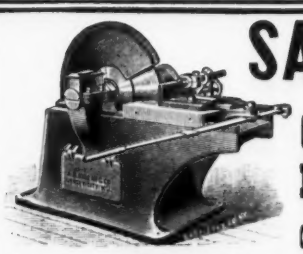

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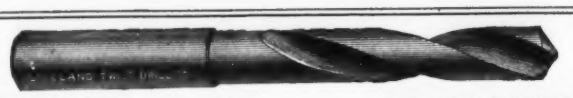

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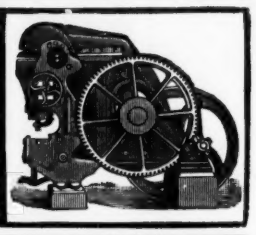

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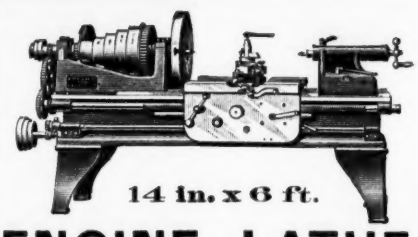

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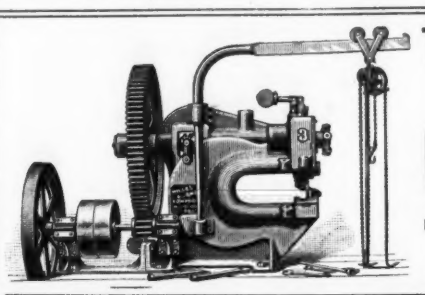

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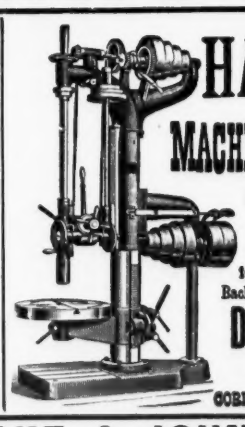

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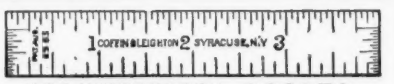

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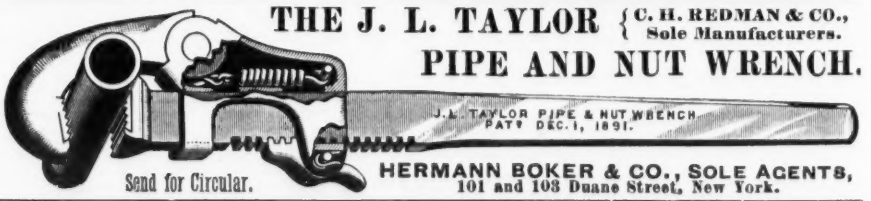

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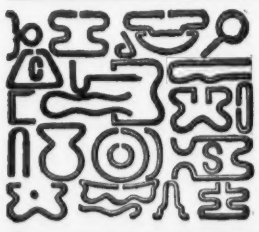

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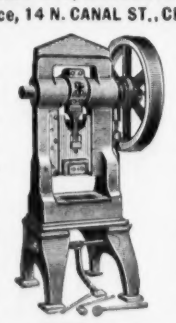

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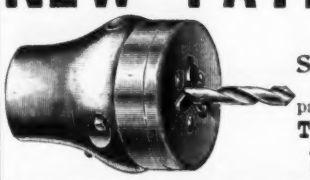

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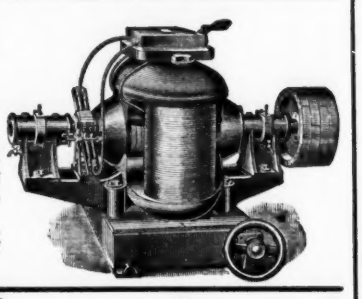

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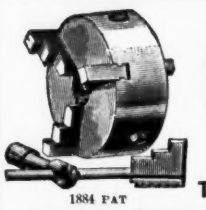

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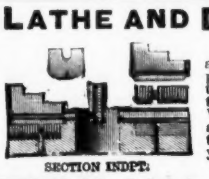

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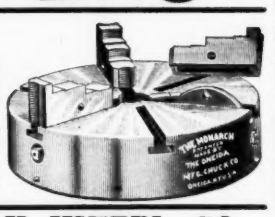

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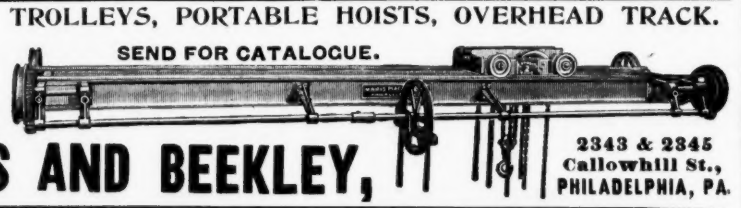

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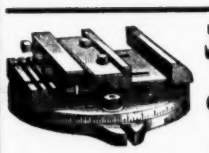

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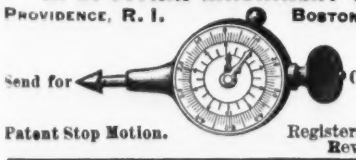

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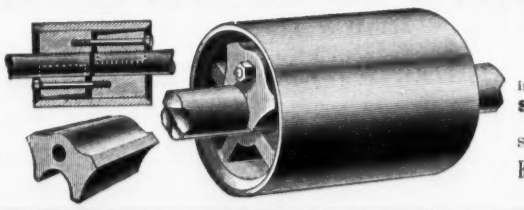

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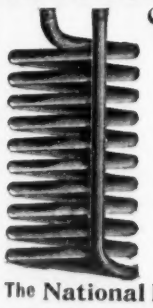

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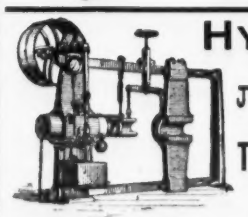

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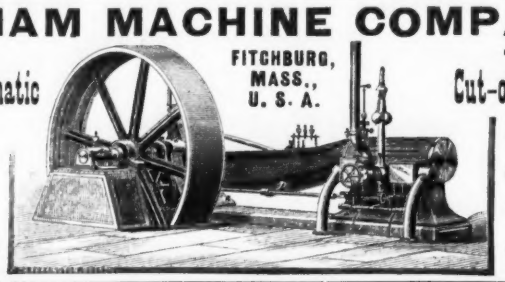

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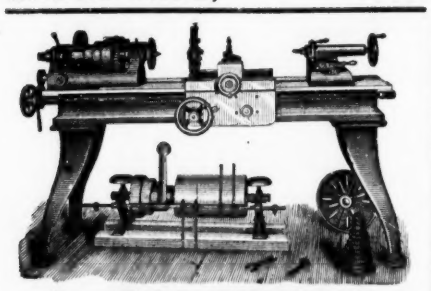

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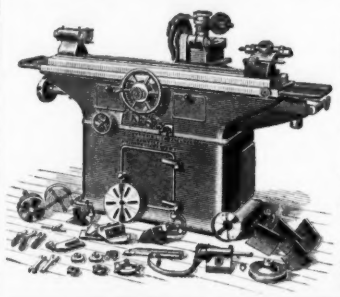

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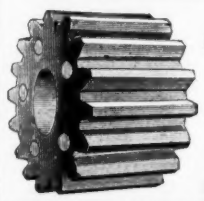

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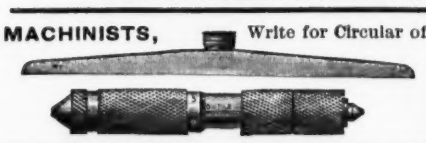

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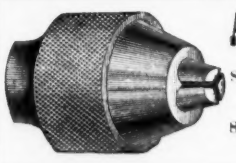

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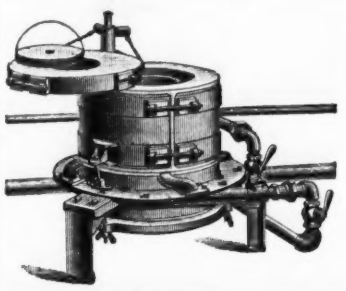

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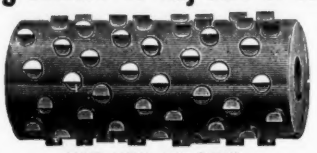

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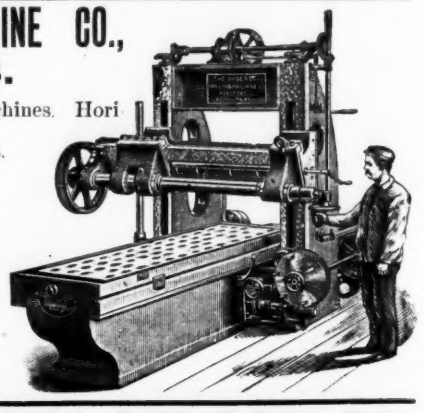

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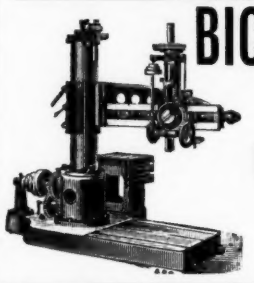

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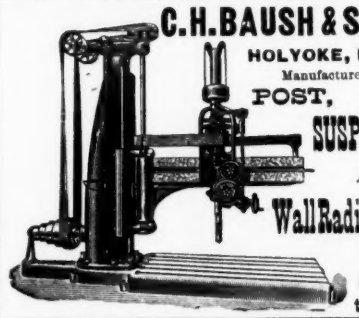

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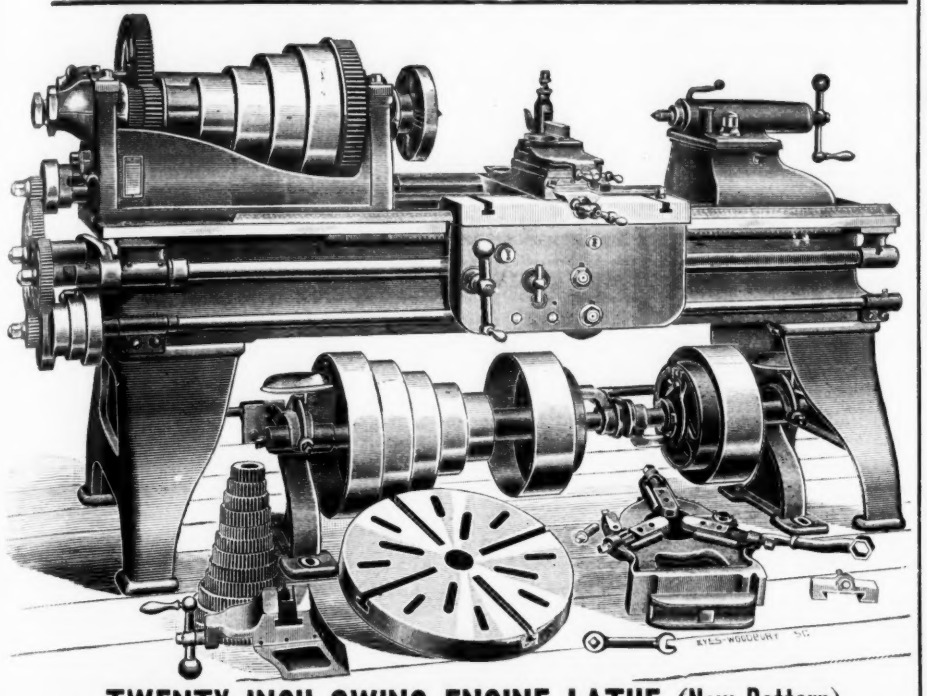

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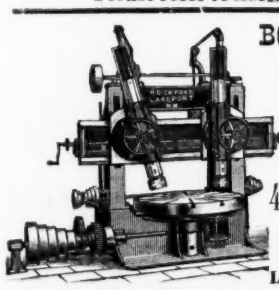

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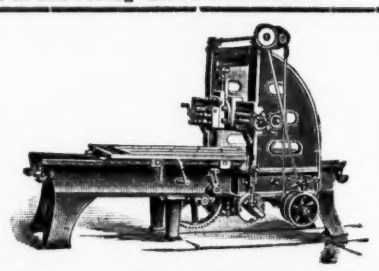

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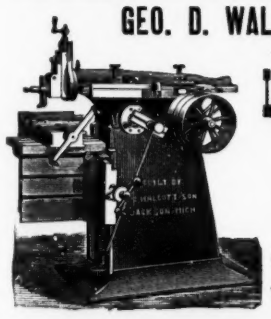

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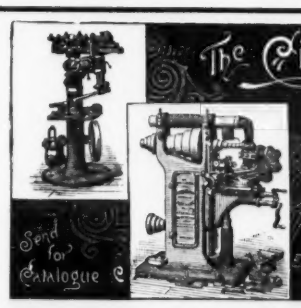

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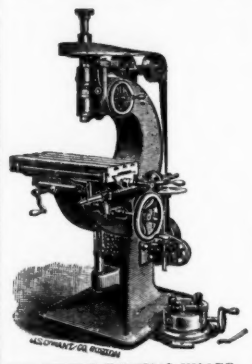

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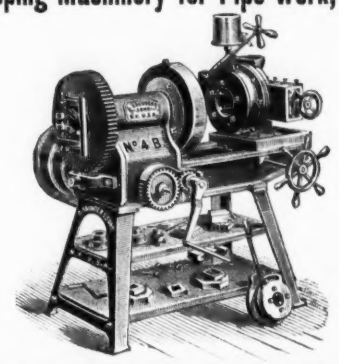

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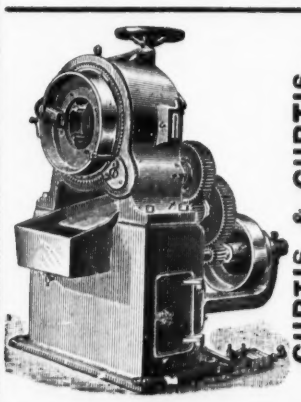

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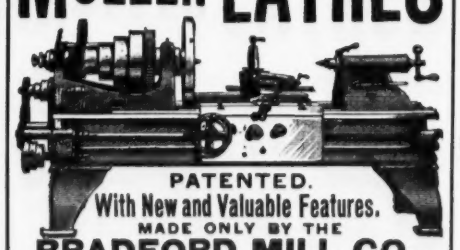

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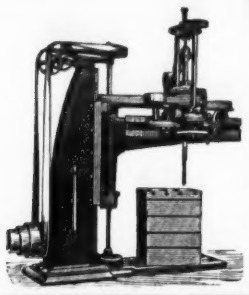

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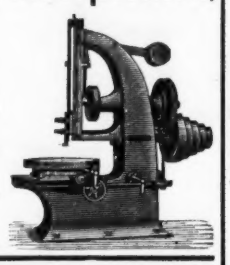

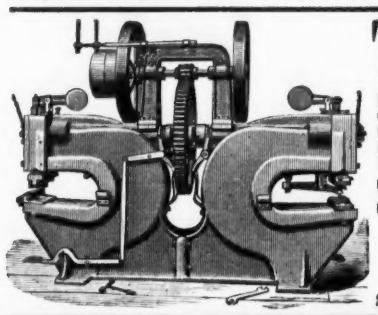

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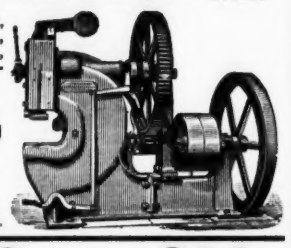

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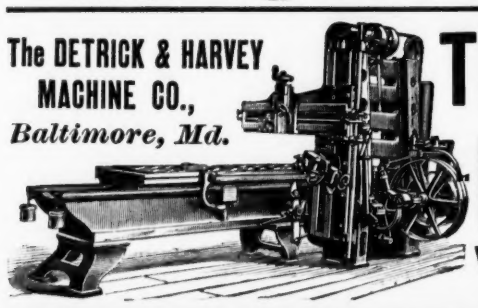

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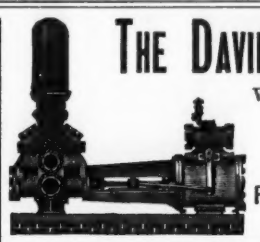

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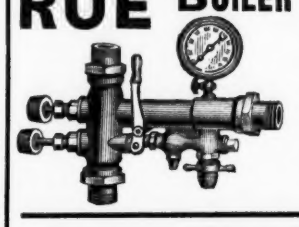

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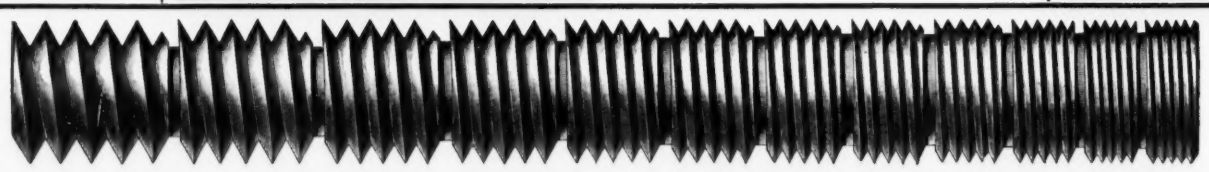

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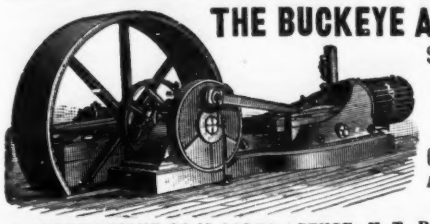

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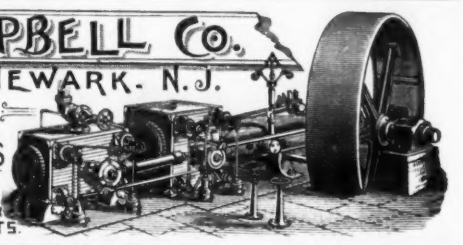

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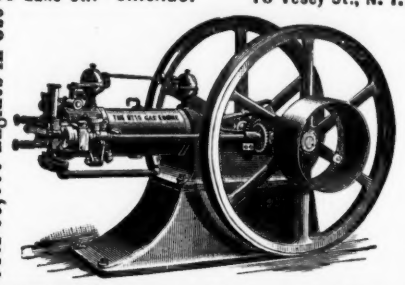

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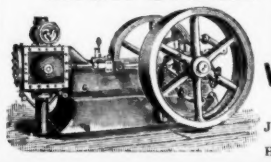

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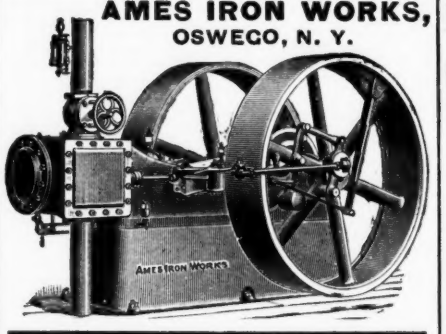

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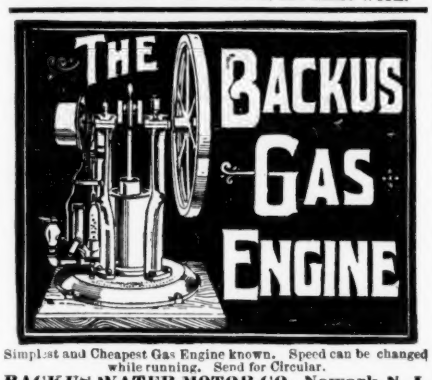

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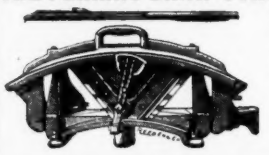

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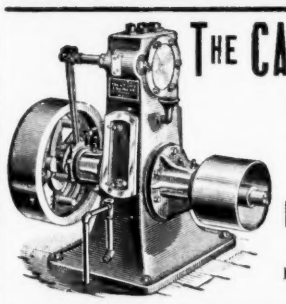

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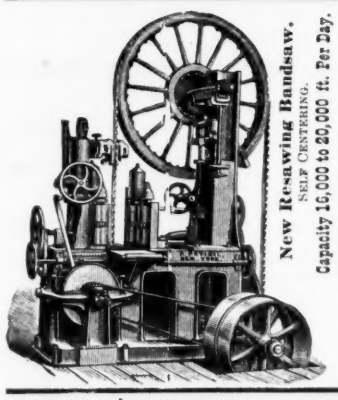

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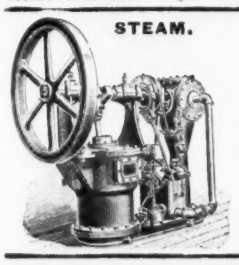

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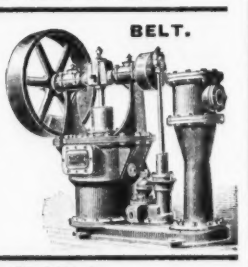

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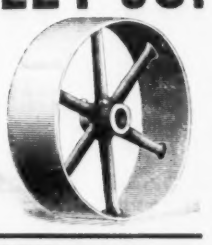

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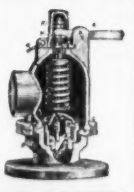

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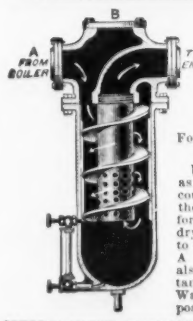

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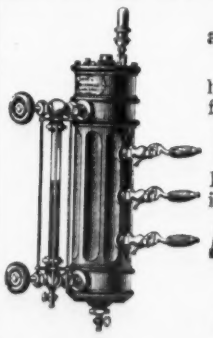

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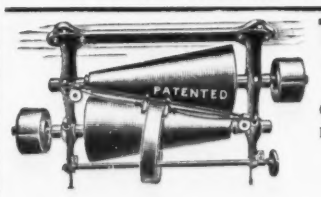

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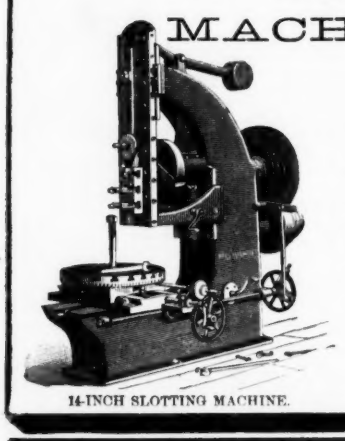

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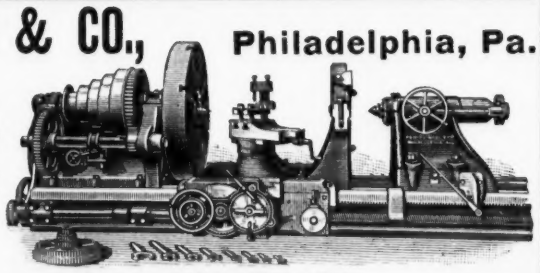

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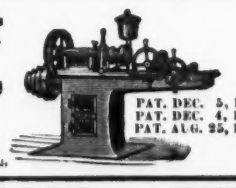

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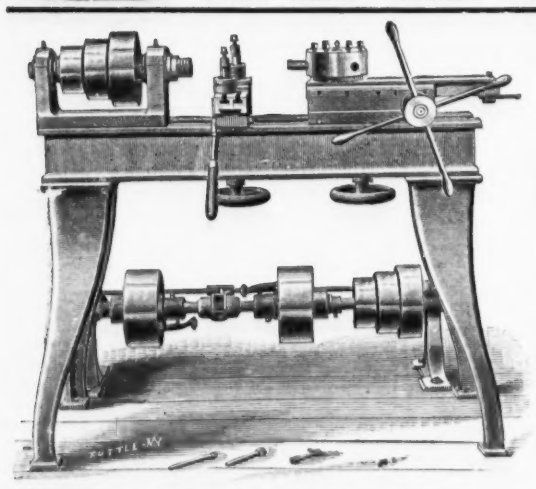
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885



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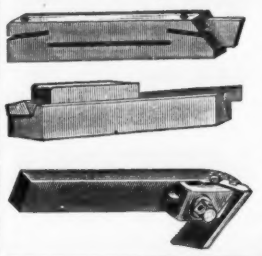

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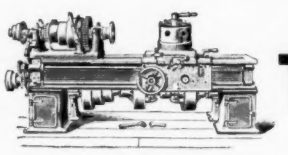

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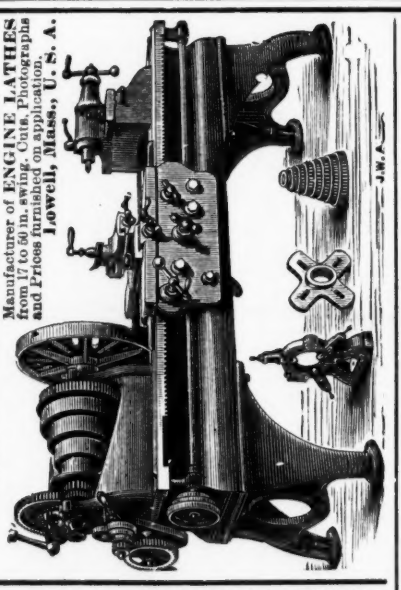

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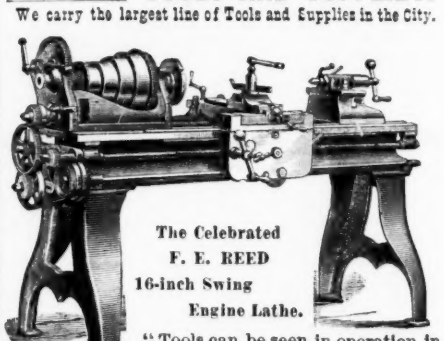

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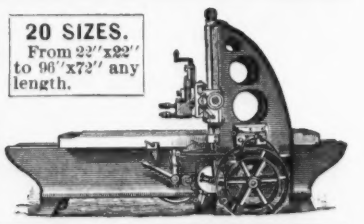

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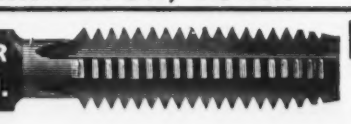

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